

## Studies on the Veronicellidae, Aperidae and Urocyclidae (Mollusca) of Southern Africa

by

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### SYNOPSIS

Slugs of the families Veronicellidae, Aperidae and Urocyclidae of the Southern African countries South Africa, Swaziland, Mozambique, Rhodesia and Malawi were studied in detail.

In the Veronicellidae the synonymy of *Veronicella saxicola* Cockerell with *Laevicaulis natalensis natalensis* (Krauss) is established.

In the Aperidae the species *Apera bruggeni* n.sp., and *Apera watsoni* n.sp. from the Transvaal, and *Apera septentrionalis* n.sp. from Rhodesia, are described.

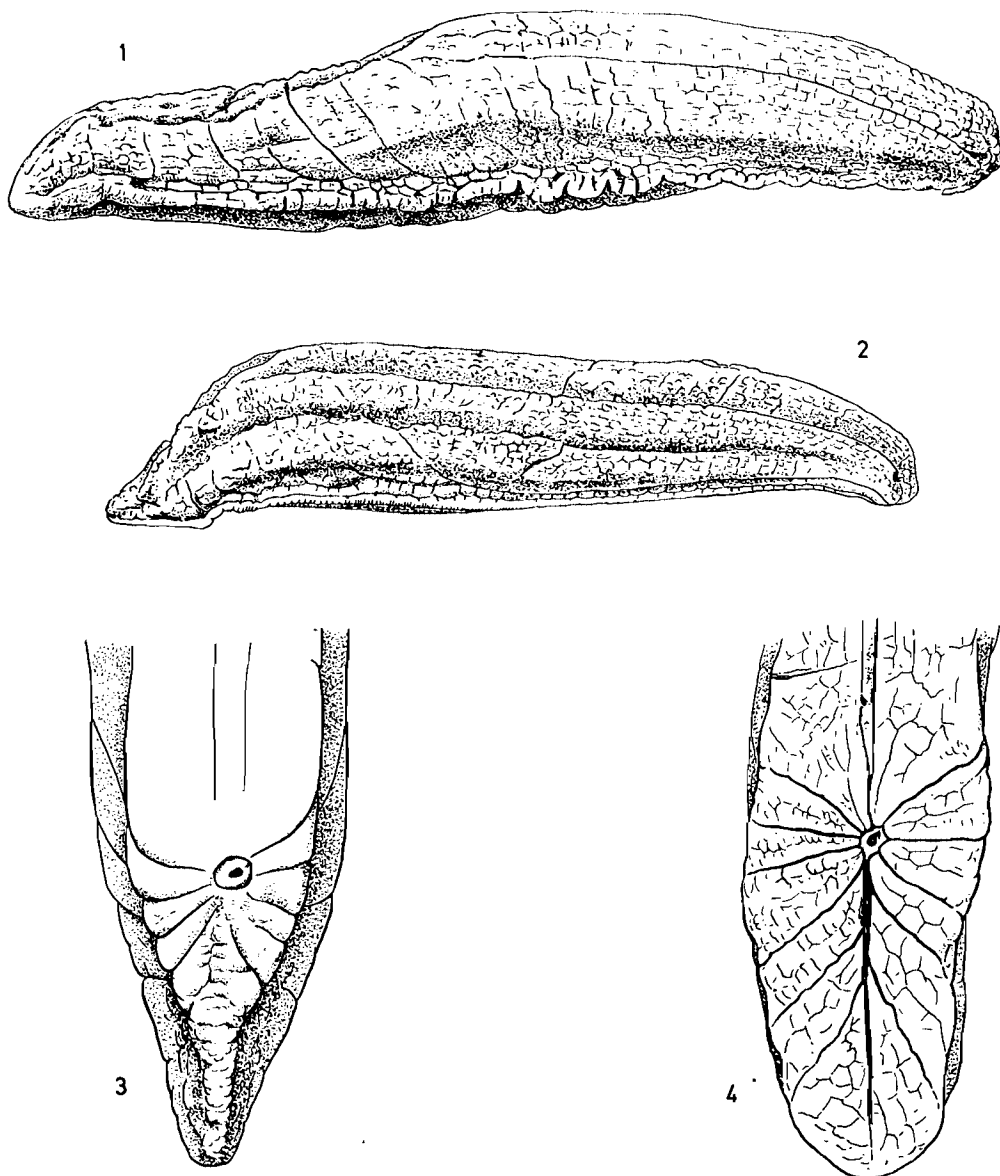
In the Urocyclidae the generic name *Trichotoxon* Simroth, to which Pilsbry attached *Spirotoxon* Simroth, *Trichotoxon* Simroth, *Atrichotoxon* Simroth, and *Polytoxon* Simroth as subgenera, is replaced by the generic name *Urocyclus* Gray. *Spirotoxon* Simroth is established as synonymous with *Urocyclus* Gray. *Elisolimax* Cockerell is now considered a subgenus of *Urocyclus* Gray. *Urocyclus* (*Urocyclus*) *kirkii* Gray and *Urocyclus* (*Elisolimax*) *flavescens* are redescribed. *Kirkia* is established as having been based on two species at the same time; consequently the name has to be rejected. *Atoxon meridionalis* n.sp. from Zululand and Rhodesia, *Atoxon bruggeni* n.sp. from Rhodesia, *Atoxon cooksoni* n.sp. from Mozambique, and *Leptichnus verdcourtii* n.sp. from Mozambique, and Rhodesia, are described. *Dendrolimax greeffi* Simroth, hitherto known only from São Thomé in the Gulf of Guinea, is now recorded from Rhodesia and redescribed. *Leptichnus verdcourtii* n.sp. from Rhodesia and Mozambique is described.

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## INTRODUCTION

Most groups of slugs from Southern African countries have been imperfectly known, many species from one or a few poorly preserved specimens. I am indebted to Dr. A. C. van Bruggen who sent 166 lots from the Natal Museum, Pietermaritzburg, and from his own collection, containing altogether 196 Veronicellidae, 26 Aperidae, and 201 Urocyclidae.



Figs. 1-4. (1) *Apera burnupi* Smith, lateral view. (2) *Apera lawrencei* Forcart, lateral view. (3) *Apera sexangula* Watson, dorsal view of hind end. (4) *Apera burnupi* Smith, dorsal view of hind end.

Most of these slugs have been recently collected, and their good preservation in 64% alcohol permitted studies of their anatomy and variation. Anatomical details are taken into account only as far as is necessary for taxonomic studies. Accounts of coloration in life are taken from notes supplied by Dr. A. C. van Bruggen; all other studies are based on preserved material.

#### ACKNOWLEDGEMENTS

I am grateful to the Director of the Natal Museum and Dr. A. C. van Bruggen<sup>1</sup> for the loan of the material and pertinent information, to Dr. Eugen Binder of the Museum of Natural History, Geneva, for the loan of the Urocyclidae described by Simroth in 1912, and of malacological literature, to Mr. S. P. Dance for informations on type-specimens in the British Museum, to Mr. O. Garraux for the execution of the drawings, to Mr. W. Suter for the photographs, and to Dr. A. C. van Bruggen and Dr. B. R. Stuckenberg for checking the manuscript.

#### GAZETTEER

##### Approximate location of places mentioned

	<i>S</i>	<i>E</i>
Amatongas Forest, Mozambique .. .. .	19° 12'	33° 42'
Andrada, Mozambique .. .. .	19° 15'	33° 15'
Barberton, Transvaal .. .. .	25° 19'	31° 02'
Bulwer, Natal .. .. .	29° 46'	29° 47'
Champagne Castle Hotel, Natal .. .. .	29° 06'	29° 20'
Chiluvo Forest, Mozambique .. .. .	19°	34° 07'
Compensation Beach, Natal .. .. .	29° 30'	31° 10'
Delagoa Bay, Mozambique .. .. .	26°	33°
Durban, Natal .. .. .	29° 49'	31° 01'
East London, Cape Province .. .. .	33°	27° 55'
Entendweni, Zululand (also Ntendweni) .. .. .	28° 10'	32° 17'
Equeefa near Umzinto, Natal .. .. .	31° 16'	30° 30'
Eshowe, Zululand .. .. .	28° 50'	31° 30'
Gondola, Mozambique .. .. .	19° 02'	33° 42'
Mt. Gorongosa, Mozambique .. .. .	18° 15'	34°
Grahamstown, Cape Province .. .. .	33° 19'	26° 31'
Gwalaweni Forest near Ingwavuma, Zululand .. .. .	27° 08'	32°
Hlabisa, Zululand .. .. .	28°	31° 45'
Hluhluwe Game Reserve, Zululand .. .. .	28° 02'	32° 17'
Ifafa, Natal .. .. .	31° 22'	30° 37'
Inhambane, Mozambique .. .. .	23° 59'	35° 31'

*continued overleaf*

<sup>1</sup>Many expeditions of A. C. and W. H. van Bruggen have been financially supported by the South African Council for Scientific and Industrial Research (C.S.I.R., Pretoria).

	<i>S</i>	<i>E</i>
Inyanga, Rhodesia .. .. .	18° 12'	32° 40'
Itumbe Forest, Mozambique .. .. .	18° 15'	34° 30'
Kologha Forest near Stutterheim, Cape Province .. .. .	32° 33'	27° 28'
Kosi Bay, Zululand .. .. .	27°	32° 53'
Kranskop, Natal .. .. .	28° 58'	30° 52'
Kruger National Park .. .. .	22° 30'	31° 15'
	25° 50'	32° 50'
Lilani near Ahrens, Natal .. .. .	29°	31°
Manaba Beach, Natal .. .. .	31°	30° 20'
Mariannhill near Pinetown, Natal .. .. .	29° 48'	30° 54'
Mariepskop, Transvaal .. .. .	24° 30'	30° 50'
Mbabane, Swaziland .. .. .	26° 18'	31° 06'
Mkuzi Game Reserve, Zululand .. .. .	27° 31'	32° 04'
Ndumu Game Reserve, Zululand .. .. .	26° 48'	32° 15'
Ngeli Forest near Kokstad, Cape Province (also Ingeli Forest) .. .. .	30° 32'	29° 29'
Ngoya Forest near Eshowe, Zululand .. .. .	28° 50'	31° 30'
Nkandhla Forest, Zululand .. .. .	28° 15'	32° 30'
Nkata Bay, Malawi .. .. .	11° 31'	34° 15'
Pietermaritzburg, Natal .. .. .	29° 35'	30° 25'
Port Alfred, Cape Province .. .. .	33° 36'	26° 55'
Port Elizabeth, Cape Province .. .. .	33° 58'	25° 40'
Port St. Johns, Cape Province .. .. .	31° 38'	29° 33'
Port Shepstone, Natal .. .. .	30° 44'	30° 28'
Pretoria, Transvaal .. .. .	25° 44'	28° 12'
Quelimane River (mouth,) Mozambique .. .. .	17° 53'	36° 58'
Richards Bay, Natal .. .. .	28° 47'	32° 05'
Richmond, Natal .. .. .	29° 53'	30° 17'
St. Lucia Bay, Zululand .. .. .	28° 30'	32° 25'
St. Lucia Game Reserve, Zululand .. .. .	28° 15'	32° 23'
St. Helier near Pinetown, Natal .. .. .	29° 48'	30° 54'
Scottsville (Pietermaritzburg), Natal .. .. .	30° 17'	30° 45'
Mt. Selinda, Rhodesia .. .. .	21° 15'	32° 20'
Somerset East, Cape Province .. .. .	32° 42'	25° 35'
Stanger, Natal .. .. .	29° 18'	31° 21'
Tugela River (mouth), Natal .. .. .	29° 14'	31° 28'
Umbonambi, Zululand (now: Kwa-Mbonambi) .. .. .	28° 40'	32°
Umfolosi River (mouth), Zululand .. .. .	28° 29'	32° 22'
Umvukwes, Rhodesia .. .. .	18°	35° 30'
Vila Pery, Mozambique .. .. .	19° 04'	33° 29'
Victoria Falls, Rhodesia .. .. .	17° 58'	25° 45'
Vumba Circular Drive, Rhodesia .. .. .	18° 45'	32° 45'
Vumba Laurenceville, Rhodesia .. .. .	18° 48'	32° 40'
Zomba Plateau, Malawi .. .. .	15° 25'	35° 16'

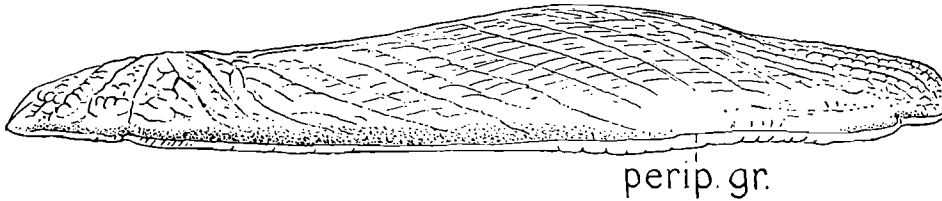
## Recent changes in the names of Countries

CONGO, formerly Belgian Congo.

MALAWI, formerly Nyasaland.

RHODESIA, formerly Southern Rhodesia.

TANZANIA, formerly Tanganyika.

Fig. 5. *Apera rubella* Watson, lateral view.

## REPRODUCTIVE ORGANS

## Explanation of abbreviations

Atr.	= atrium.
B.	= bursa of receptaculum seminis.
Dh.	= hermaphrodite duct.
Ep.	= epiphallus.
Fl. ep.	= epiphallian flagellum.
Fl. p.	= penial flagellum.
Gl. alb.	= albumen gland.
Gl. h.	= hermaphrodite gland.
Gl. ut.	= uterine gland.
Gy.	= gypsobelum.
Ovsp.	= ovispermiduct.
P.	= penis.
P. pap.	= penial verge.
Ped.	= pediculus of receptaculum seminis.
R.p.	= penial retractor.
Sp.	= spermatophore.
Stim. org.	= stimulatory organ.
Styl.	= stylophor.
Ut.	= uterus.
V.s.	= vesicula seminis.
Vag.	= vagina.
Vd.	= vas deferens.

## Glossary and Synonymy of terms

**Albumen gland (Gl. alb.).** Gland on distal end of ovispermiduct. "Eiweissdrüse" in Simroth 1883, pl. 9, fig. 3 (Gal.), Simroth 1889: 89, pl. 4 (ei), Simroth 1910: 620 figs. 4A, 6A-9A, 15A, 16A (al), Simroth 1912, pl. 3, figs. 1A, dD (ei). "Glande de l'albumen" in Poirier 1887: 229, pl. 6 (ga). "Glande de l'albumine" in Germain 1935: 30, fig. 4 (ga).

**Atrium (Atr.).** Terminal cavity of the reproductive organs inoculated by male and female ducts, connected with the outside of the body through the genital orifice. "Atrium genitale" in Simroth 1910: 620, figs. 14, 15 (a.g.). "Genital atrium" in Watson 1915: 267, pl. 23 (gen. atr.).

**Bursa of receptaculum seminis (B.).** See under receptaculum seminis. "Poche copulatrice" in Germain 1935: 20, fig. 4 (pc). "Receptaculum seminis" in Watson 1915: 267, pl. 23 (rec. sem.). "Spermatheca" in Pilsbry 1919: 289, fig. 147 (sp.); Verdcourt 1960: 203.

**Epiphallian flagellum (Fl. ep.).** A blind diverticulum as a prolongation of the epiphallus at the insertion of the vas deferens. "Erste Kalkdrüse" in Simroth 1883: 312, pl. 9, fig. 3 ( $K_1$ ). "Erstes Kalksäckchen" in Simroth 1889: 61, pl. 4, fig. 2 ( $K_1$ ). "Flagellum" in Pilsbry 1919: 289 fig. 146, 292 fig. 148b (Fl.); Verdcourt 1960: 201. "Glande calcaire" in Poirier 1887: 229, pl. 6 (k); Germain 1935: 20, fig. 4 (gc).

**Epiphallus (Ep.).** Male duct between vas deferens and penis. "Patronenstrecke" in Simroth 1889: 61. "Région pénio-déférente" in Poirier 1887: 229, pl. 6 (pd). "Spermatophorenstrecke" in Simroth 1889: 89, pl. 3, figs. 8, 15 (pat).

**Glans.** Proximal portion of penial verge.

**Gypsobelum (Gy.).** Hollow, needle-like calcareous organ in the stimulatory organ for transferring the secretion of the stylophor to the copulation-partner. As the gypsobelum itself is probably not transferred to the copulation partner it does not have the function of a dart. "Dart" in Pilsbry 1919: 295; Verdcourt 1960: 201. "Kalkpfeil" in Simroth 1904: 703, pl. 40, fig. 55 (pf). "Liebespfeil" in Simroth 1912: 62, pl. 3, fig. 4E (pf).

**Hermaphrodite duct (Dh.).** Duct between hermaphrodite gland and ovispermiduct. "Canal efférent" in Poirier 1887: 229, pl. 6 (c.e.). "Canal hermaphrodite" in Germain 1935: 20, fig. 4 (ch.). "Zwittergang" in Simroth 1883: 312, pl. 9, fig. 3 (Zw).

**Hermaphrodite gland (Gl. h.).** Gonads or germinal glands. "Glande hermaphrodite" in Poirier 1887: 229, pl. 6 (h); Germain 1935: 20 fig. 4 (gl). "Ovotestis" in Pilsbry 1919: 292, fig. 148 (ov). "Zwitterdrüse" in Simroth 1883: 312, pl. 9, fig. 3 (Zwd); Simroth 1889: 53, pl. 4, fig. 2 (zd).

**Ovispermiduct (Ovsp.).** Common part of oviduct and spermiduct. "Common duct" in Watson 1915: 266, pl. 23 (com. d.). "Oviduct + prostata" in Poirier 1887: 229, pl. 6 (o + pr); Germain 1935: 20, fig. 4 (ov + pr). "Spermoviduct" in Simroth 1912: 62, pl. 3 figs. 1A, 3A, 4D (osp).

**Pediculus of receptaculum seminis (Ped.).** See under receptaculum seminis. "Bursagang" in Simroth 1910: 620, figs. 4A-6A, 7A, b, 9A, 10A, 14A, 15A ( $b^1$ ). "Duct of spermatheca" in Verdcourt 1960: 203. "Receptacular duct" in Watson 1915: 267, pl. 23 (rec. d.).

**Penial flagellum (Fl. p.).** A blind diverticulum as a continuation of the penis at the insertion of the epiphallus. "Flagellum" in Poirier 1887: 229, pl. 6 (fl); Simroth 1910: 620, figs. 4A-10A, 12A, 14A-16A (fl); Simroth 1912: 62, pl. 3 figs. 1A-3A, 4D (fl); Germain 1935: 20, fig. 4 (fl). "Lime gland" in Pilsbry 1919: 289, fig. 146 (lg), 292, fig. 148b (lg); Verdcourt 1960: 233. "Upper flagellum" in Verdcourt 1960: 205, fig. 3 (fl). "Zweite Kalkdrüse" in Simroth 1883, pl. 9, fig. 3 ( $K_2$ ). "Zweiter Kalksack" in Simroth 1889: 61, pl. 4, fig. 2 ( $K_2$ ).

**Penial retractor (R. p.).** Retractor muscle of penis.

**Penial sheath (P. sh.).** See under penis.

**Penial verge (P. pap.).** See under penis. "Glans" in Simroth 1896: 302, Simroth 1912: 62, pl. 3, fig. 1C (gl). "Glans penis" in Simroth 1910: 620, figs. 4C, E, 5C, 10C, 15B, C (gl).

**Penis (P.).** Male copulatory organ. In the families under discussion two different penial types are present: 1. The penis is a simple duct, everted when copulating (Aperidae). 2. The penial duct ends as a penial verge in the penial sheath. In copula the penial sheath is everted and the penial verge protrudes (Veronicellidae, Urocyclidae). "Patronenstrecke" in Simroth 1883: 312, pl. 9, fig. 3 (Spt.). (Simroth describing for the first time the anatomy of an *Urocyclus*, in error interpreted the stimulatory organ as penis and the penis as epiphallus.) "Region penio-vaginale" in Poirier 1887: 229, pl. 6 (pv).

**Receptaculum seminis.** Organ for storage of received spermatozoa after copulation. It consists of the bursa (B.) and pediculus (Ped.). "Poche copulatrice" in Poirier 1887: 229, pl. 6 (pc).

**Spermatophore (sp.).** Elongate body consisting of the hardened secretions of the epiphallus and containing the spermatozoa. Its function is to ensure the transfer of the spermatozoa from one individual to the receptaculum seminis of another.

**Stimulatory organ (Stim. org.).** In *Urocyclus* it is a combined atrium-stimulatory organ. "Combined atrium and dart sac" in Pilsbry 1919: 295. "Dart sac" in Pilsbry 1919: 298, fig. 151b (ds); Verdcourt 1960: 201, 237, fig. 8 (ds). "Penis" in Simroth 1883: 312, pl. 9, fig. 3 (p)—see explanation of "Patronenstrecke" under penis. "Pfeilsack" in Simroth 1896: 287, fig. 4 (pf), Simroth 1904: 703, pl. 10, figs. 52-55 (pf); Simroth 1910: 621 figs. 5-8, 10-12, 14, 16 (pfd).

**Stylophore (Styl.).** Gland and muscular part enclosing the gypsobelum in the stimulatory organ. "Pfeilsack" in Simroth 1910: 621, figs. 4 A, E (pfs).

**Uterine gland (Gl. ut.).** Gland embracing a part of the uterus. "Glandular portion of oviduct" in Pilsbry 1919: 292, figs. 148 a, c (gl. ov.). "Muskulöse Erweiterung des Eileiters" in Simroth 1889: 61, pl. 4, fig. 2 (od). "Nidamentaldrüse" in Simroth 1910: 621, figs. 4B, 5A, 7A, B, 8A, B, 9A (n.d.).

**Uterus (Ut.).** Part of oviduct between ovispermiduct and inosculature of receptaculum seminis or insertion in atrium. "Free oviduct" in Watson 1915: 267, pl. 23 (f. ov.). "Losgelöster Eileiter" in Simroth 1896: 287, fig. 4 (ov), 302, fig. 7 (od). "Oviducte libre" in Germain 1935: 20, fig. 4 (ovl).

**Vagina (Vag.).** Part of oviduct between insertion of receptaculum seminis and atrium, stimulatory organ or opening to the exterior. "Atrium" in Simroth 1896: 302, fig. 7 (at).

**Vas deferens (Vd.).** Male duct between ovispermiduct and epiphallus or penis. "Canal déférent" in Poirier 1887: 229, pl. 6 (cd); Germain 1935: 20, fig. 4 (cd).

**Vesicula seminalis (V. s.).** Vesicle at the proximal end of the hermaphrodite duct, embedded in the albumen gland.

## I. Family VERONICELLIDAE Gray

Veronicellidae Gray, 1847. Proc. zool. Soc. Lond., 15: 178.

### Genus *Laevicaulis* Simroth

*Laevicaulis* Simroth, 1913. In Voeltzkow, Reise Ostafrika, 3 (3): 147, 202. Type-species, selected by Pilsbry (1919: 316): *Vaginula comorensis* Fischer, 1883.—Forcart 1953, Ann. Mus. Congo Belge, Zool. (8°) 23: 62-63 with synonymy.

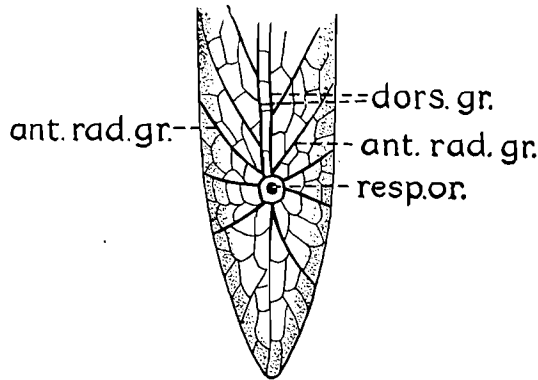


Fig. 6. *Apera purcelli* Collinge, dorsal view of hind end (after Watson). ant. rad. gr. = anterior or first radial groove. dors. gr. = dorsal grooves. resp. or. = respiratory orifice.

*Laevicaulis natalensis natalensis* (Krauss)

*Vaginulus natalensis* "von Rapp" Krauss, 1848. Südafrik. Moll.: 72. Type-locality: Natal.

*Veronicella saxicola* Cockerell, 1893. Conchologist, 2 (8): 194, 216. Type-locality: Cape Prov., Port Elizabeth.

*Laevicaulis natalensis natalensis* (Krauss).—Forcart 1953, Ann. Mus. Congo Belge Zool. (8°) 23: 68-71 with synonymy.—Forcart 1963, Proc. Malac. Soc. Lond., 35 (2/3): 104-105, pl. 11.

*Laevicaulis saxicolus* (Cockerell).—Forcart 1953, op. cit.: 89 with synonymy.—Forcart 1963, op. cit.: 105.

**Taxonomic notes:** For the first publication on all African Veronicellidae (Forcart 1953) only four specimens from South Africa, described (p. 89) as *Laevicaulis saxicolus*, were at my disposal. Ten further specimens have been examined for a later publication (Forcart, 1963), of which one was described as *L. saxicolus*, and nine as *L. natalensis natalensis*. Recently 161 specimens of 72 lots have been examined, of which a great number has been dissected. It has now been proved that *L. natalensis natalensis* and *saxicolus* are not different species. The differences of the penial verge, on which the species have been separated, are modifications, caused by different degrees of invagination of the distal end of the verge, analogous to those of *L. stuhlmanni* (cf. Forcart 1953: pl. 5 figs. 1 b-e). The phase figured by Hoffmann (1925: pl. 5, fig. 45-b-2) and copied by Forcart (1953: pl. 4, fig. 8; 1963: pl. 11, fig. 1) is rarely observed: it was found in only two other specimens (from Pietermaritzburg). Forcart (1953: 22, 71) mentioned the ratio, breadth of the foot-sole/breadth of the hyponotum, as a specific character distinguishing *L. natalensis natalensis* and *L. natalensis brauni*; in the first subspecies the foot-sole is broader than (exceptionally as broad as) the hyponotum, while in the other it is narrower. This relation has been checked in 42 adult specimens of *L. natalensis natalensis*. The breadth of the foot-sole is in 28 specimens narrower, in three as broad as, and in 11 broader than the hyponotum. This particular feature thus varies within *L. natalensis natalensis*, and is therefore no stable character to differentiate the two subspecies. They differ in their penial verge, which in *L. natalensis brauni* is proximally incrassate, showing a narrow subdistal annular swelling.

Comparison of the description of *Vaginulus natalensis* var. from Mozambique, as given by Gibbons (1879: 140-141) and of *Vaginula maura* Heynemann (1885: 7, pl. 1, figs. 6, 7;



1885a: 104) from Delagoa Bay, with *L. natalensis natalensis* and *L. alte*, and the dissection of a similarly dark-coloured specimen from Mbabane in Swaziland, confirmed that they all belong to the former species.

*Habitus illustrations:* Heynemann 1885: pl. 1, figs. 6, 7 = *Vaginula maura* from Delagoa Bay.—Forcart 1953: pl. 2, figs. 9 a-c = *Laevicaulis saxicolus* from Durban.—Forcart 1963: pl. 11, figs. 3 a-b from Pretoria.

*Body measurements:* Hoffmann 1925: 224-225.—Forcart 1953: 67 Tabl. 15, 88 Tabl. 23 = *L. saxicolus*.—Forcart 1963: 105 Tabl. 1.

*Anatomy:* Hoffmann 1925: 134-135, 224-225, pl. 5, fig. 45-b-2.—Forcart 1953: pl. 4, fig. 8, 89 and pl. 5, figs. 6 a-b = *L. saxicolus*.—Forcart 1963: 105, pl. 11, figs. 1-2.

*Live colours* (as noted by van Bruggen): Brown with spots and paler stripe in the middle, four specimens from Inyanga, 1800 m (Rhodesia). Brownish with pale yellow stripe in the middle, two specimens from Mt. Selinda, Chirinda Forest (Rhodesia). Four brownish and one gray specimen from Ndumu Game Reserve (Zululand). Pale yellowish brown with darker spots, one specimen from Pietermaritzburg (Natal).

*Distribution:* The range of *Laevicaulis natalensis natalensis* extends from about 18°S in Rhodesia and Mozambique to the south-eastern Cape Province. In the west it reaches 32° 40' in Rhodesia, 28° 12' in Transvaal, 30° 25' in Natal, and 25° 40' in the Cape Province. In the east the area of distribution is bordered by the Indian Ocean.

*Hypsometrical distribution:* *L. natalensis natalensis* lives from sea-level to about 1800 m.

*Localities:* Rhodesia: Inyanga near Rhodes-Inyanga Hotel, 1800 m, leg. A. C. & W. H. van Bruggen 20.21.II.1963.—Vumba, Laurenceville, forest, 1370 m, leg. A.C. & W. H. van Bruggen 15.-16.II.1963.—Mt. Selinda, Chirinda Forest, 1100 m, leg. A. C. & W. H. van Bruggen 7.-13.II.1963.

Mozambique: Chiluvo Forest, leg. D. M. Cookson 16.I.1964.—Delagoa Bay (Gibbons 1879: 141. Heynemann 1885: 7-8 = *Vaginula maura*).

Swaziland: Mbabane, leg. R. F. Lawrence XI.1964.

Transvaal: Mariepskop, in forest, leg. B. R. Stuckenberg 4.X.1956.—Pretoria, Hatfield, leg. H. K. Munro 1961-1963; Groenkloof garden, leg. L. Vári 4.II.1965.—Barberton (Forcart 1963: 105).

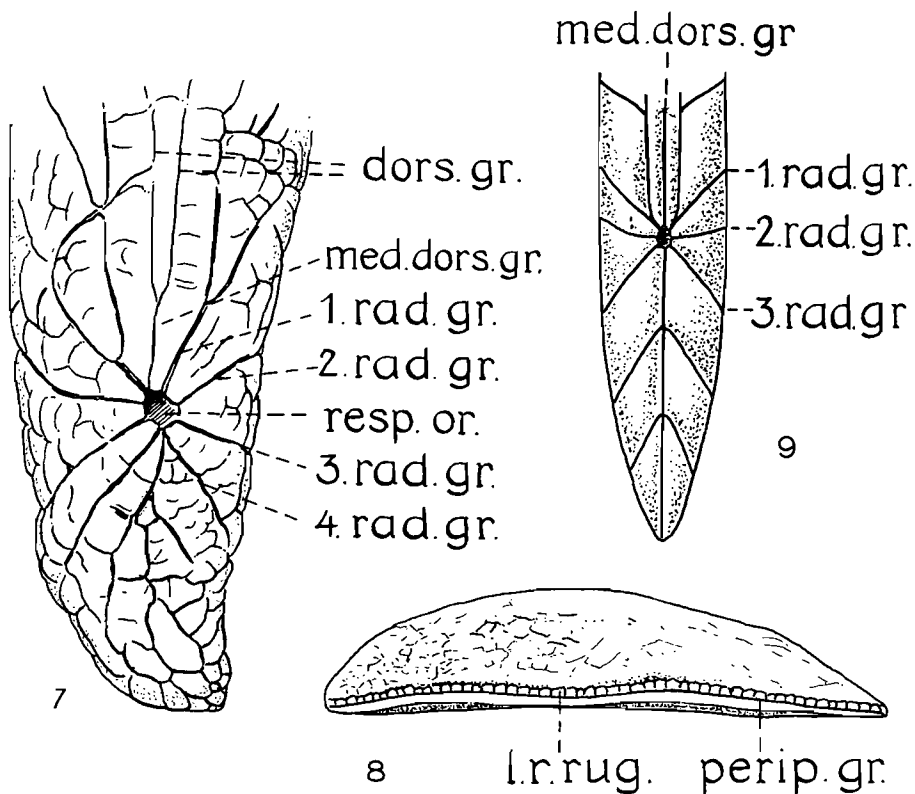
Kruger National Park: Block N 5, Pafuri near border, leg. Biologist K.N.P. 18.XII.1962.—Block N 28, Malonga spring under logs, leg. U. de Pienaar c.s. 3.V.1962.—Block N 119, Shingwidzi staff quarters, leg. Biologist K.N.P. 13.IV.1961; north and south of Shingwidzi river, riverine forest, leg. A. C. van Bruggen 2.V.1962.—Block C 52, Pumbe, under stones, leg. A. C. van Bruggen 29.IV.1962.—Block C 71, Satara Rest Camp, leg. A. C. van Bruggen 22.II.1964.—Block C 72, Shibotwane, leg. A. C. van Bruggen 22.II.1964.—Block C 84, Satara Road, leg. A. C. van Bruggen 21.II.1964.—Block C 91, Sweni firebreak, sandstone ridges, leg. A. C. van Bruggen 29.II.1964.—Block C 165, Salitjie Road, rocky koppie, leg. A. C. van Bruggen 20.II.1963.—Block S 7, Skukuza, leg. Biologist K.N.P. IV.-V.1961, 8.-15.XII.1962.—Block S 35, Manung Kop, leg. R. F. Lawrence 2.XII.1963.—Block S 74, Godleni, leg. A. C. van Bruggen I.III.1964.—Block S 107, Beacon A, Lebombo Range, under stones, leg. A. C. van Bruggen 28.IV.1962, I.III.1964.—Block C 136, Nwamuriwa Hill, leg. A. C. van Bruggen 21.II.1964.

Zululand: Kosi Bay (Forcart 1963: 105).—Mkuzi Game Reserve, sand forest, leg. D. E. van Dijk V.-VII.1962; on road to gate, 5 miles from camp, under stones, leg. A. C. & W. H. van Bruggen 8.I.1964; as part of stomach contents of a Mongoose *Ichneumia albicauda* (Cuvier), leg. J. E. Dixon 8.VIII.1962.—Ndumu Game Reserve, Pongola River forest near pumphouse; fig tree forest at confluence Usutu- and Pongola Rivers; around Nyamiti Pan, leg. A. C. & W. H. van Bruggen 11.-14.I.1964.—Hluhluwe Game Reserve (Forcart 1963: 105 and leg. P. Brinck of the Swedish South Africa Exp. 18.IV.1951).—St. Lucia Bay (Forcart 1963: 105). St. Lucia Game Reserve, Charters Creek rest camp, leg. A. C. van Bruggen 19.V.1965.—Entendweni, leg. F. Toppin VI.1905.—Umbonambi, leg. F. Toppin V.1905.

Natal: Kranskop, indigenous forest, leg. A. C. & W. H. van Bruggen 28.XI.1963.—Compensation Beach, leg. ?.—Pietermaritzburg, leg. W. G. Rump; Scottsville garden, leg. B. R. Stuckenberg II., III., XII. 1962, XI.1964; Town bush, leg. ? 1904; Loop Street, leg. E. Warren III.1913; Alexandra Park in clusters under leaves on the ground, leg. Dept. of Zoology, University of Natal, VII.1963; Winterskloof 900 m., leg. T. B. Oatley 13.X.1963; Cordwalles School grounds, leg. D. Brooks 28.I.1963; Natal University grounds, leg. J. A. Pringle 1.IV.1964.—Marianhill near Pinetown (Hoffman 1925: 224-225).—Durban (Gibbons 1879: 140-141. Simroth 1892: 70. Germain 1935: 49-50. Forcart 1953: 89, 1963: 105 = *L. saxicolus*);

Bluff, leg. F. G. Cawston IV.1945; Stella Bush, leg. F. Toppin 1905.—Port Shepstone, leg. H. C. Burnup 1912.—Manaba Beach, bush, leg. Mrs. B. L. Cock 1964.

Cape Province: East London, leg. W. H. Archer V.-VI.1964; Cambridge leg. Godfrey X.1926.—Port Alfred (Hoffman 1925: 224-225).—Port Elizabeth (Cockerell & Collinge 1893: 194, 216 = type-locality of *Veronicella saxicola* Cockerell, 1893).



Figs. 7-9. (7) *Apera rubella* Watson, dorsal view of hind end. dors. gr. = dorsal grooves. med. dors. gr. = median dorsal groove. resp. or. = respiratory orifice. 1-4 rad. gr. = first to fourth radial grooves. (8) *Apera dimidia* Watson, lateral view (after Watson). perip. gr. = peripodial groove. l. r. rug. = lowest row of rugae. (9) *Apera parva* Watson, dorsal view of hind end (after Watson). med. dors. gr. = median dorsal groove. 1-3 rad. gr. = first to third radial grooves.

### *Laevicaulis alte* (Férussac)

*Vaginulus alte* Férussac, 1821. Tabl. syst. Limaces: 14; Hist. Nat. Moll.: pl. 8A fig. 8, pl. 8B fig. 6. Type-locality: India, Pondicherry.

*Vaginula maura*.—Germain 1935, Mem. Es. Mus. Zool. Coimbra, (1) 80: 47-49, figs. 8, 9 non *Vaginula maura* Heynemann, 1885 = synonym of *Laevicaulis natalensis* (Krauss).

*Laevicaulis alte* (Férussac).—Forcart 1953, Ann. Mus. Congo Belge. Zool. (8°) 23: 63-68 with synonymy.

**Taxonomic notes:** It is evident that the species with dark hyponota from Mozambique, as described by Germain (1935: 47-49), is synonymous with *Laevicaulis alte*, and not with *L. maura* Heynemann, the latter being a synonym of *L. natalensis natalensis*.

*Habitus illustrations:* Férrussac & Deshayes 1819-1851: pl. 8A, fig. 8, pl. 8B, fig. 6 from India, Pondicherry.—Forcart 1953: pl. 2, figs. 4 a, b from Congo, Boma.

*Body measurements:* Grimpe & Hoffmann 1925: 350-357, tab. II, 366-367.—Forcart 1953: 64, tab. 14.

*Anatomy:* Grimpe & Hoffmann 1925: 362-365, figs. 3b, 4b, 5b, 6b, 8b, 10 a-c, pl. 6, figs. 4-6.—Hoffmann 1925: 226-227, p. 5, fig. 45-b-4.—Forcart 1953: 66, pl. 4, figs. 7 a-c.

*Live colours* (as noted by van Bruggen): Two specimens dark gray, one specimen dark gray with white stripe in middle from Mt. Selinda, Chirinda Forest 1100 m. (Rhodesia) leg. A. C. & W. H. van Bruggen 7.-13.II.1963). Dark gray with irregular paler line on back, one specimen from Pietermaritzburg.

*Distribution:* *L. alte* was hitherto known in Africa from Congo, Angola, Tanzania, Malawi, and Mozambique. The new material extends its known African distribution southward to the Cape Province where it has been found at Port St. Johns. The hypothesis that *L. alte*, now widely distributed in tropical countries, is primarily an African species which was spread with cultivated plants (Forcart 1953: 68), is supported by the fact that some of its African localities are far distant from cultivated regions. A. C. van Bruggen informed me (*in litt.*) that the localities in the Chirinda Forest on Mt. Selinda (Rhodesia), in the Kruger National Park (Transvaal), and in the Nkandhla Forest (Zululand), are rather remote, not on main roads, and not frequently visited by collectors. Very probably the primary range of *L. alte* extended along the east coast of Africa from Tanzania to Zululand and the species was spread from that region to other tropical areas. *L. alte* easily adapts itself to new ecological conditions, and obviously this has made possible its extensive distribution.

*Hypsometrical distribution:* Most African habitats are situated between sea-level and 550 m. Higher altitudes are reached only rarely, as at Vumba, Laurenceville (Rhodesia), 1370 m.

*African localities south of 10° latitude:* Malawi, Nkata Bay, 550 m, leg. T. B. Oatley 17.V.1964.—Fort Johnston, Cherdulga Mountains, West Shire, Lisunga River (Forcart 1953: 66, 68).

Mozambique: Amatongas Forest, leg. D. M. Cookson 15.-16.II.1964.—Mozambique (Forcart 1953: 66).—Lac Cangaré on the Zambesi between Chemba and Tete (Germain 1935: 49 = *Vaginula maura*).—Quilimane (Hoffmann 1925: 228).—Inhambane (type-locality of *Vaginulus petersi* Martens, 1879: 736).

Transvaal: Kruger National Park: Block N 30, Dimbo Rand, 1 mile W Punda Maria, leg. U. de V. Pienaar 1.V.1962.—Block N 38, Shipudze Road, leg. U. de V. Pienaar 2.V.1962.

Zululand: St. Lucia Game Reserve, Charters Creek rest camp, leg. J. S. Taylor 23.X.1964.—Nkandhla Forest 1100-1200 m, under log, leg. A. C. & W. H. van Bruggen 17.I.1964.

Natal: Pietermaritzburg, leg. W. G. Rump V.1938; garden in Topham Road, leg. A. C. van Bruggen 13.XII.1962; Scottsville garden, leg. S. F. Bush 1936/40 and J. A. Pringle 10.III.1962.

Cape Province: Port St. Johns, forest, leg. W. G. Rump VIII.1937.

*Laevicaulis striatus* (Simroth)

*Vaginula striata* Simroth, 1896. Nacktschnecken Ostafrikas: 16. Type-locality: Congo, Prov. Stanleyville, Distr. Kibali-Ituri "West Lindu Massiba  $\pm 2^{\circ}\text{N } 30^{\circ}10'\text{E}$ ".

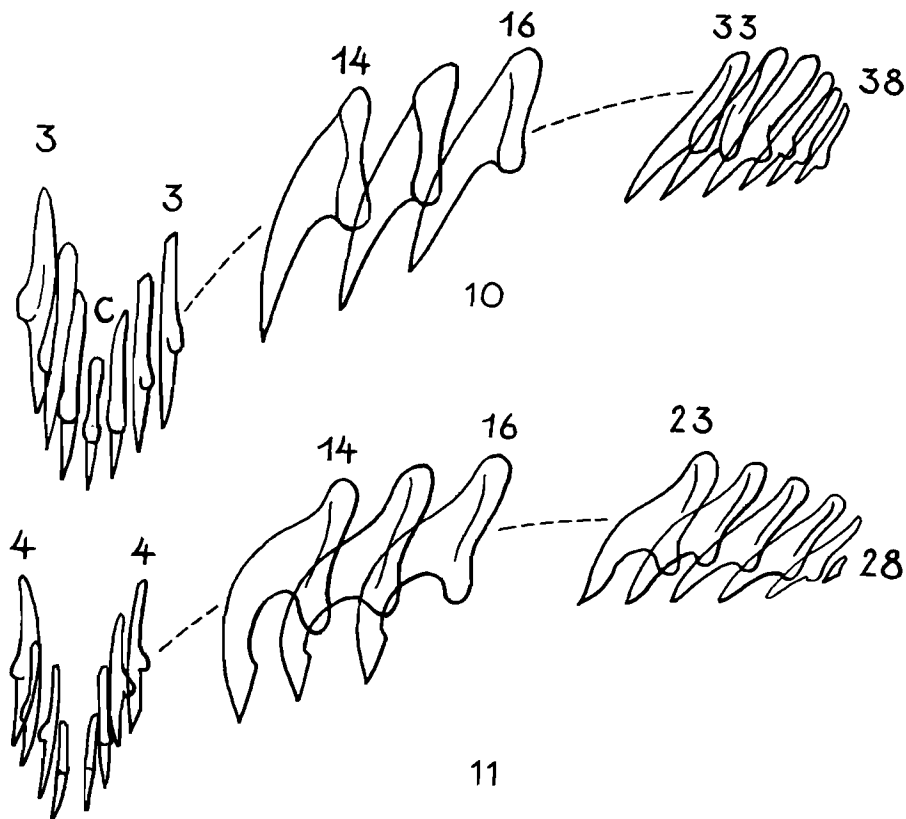
*Veronicella obscura*?—Connolly 1939, Ann. S. Afr. Mus., 33: 452.

*Laevicaulis striatus* (Simroth).—Forcart 1953, Ann. Mus. Belg. Congo. Zool. (8°) 23: 79-86 with synonymy.

**Habitus illustrations:** Simroth 1896a: pl 2, figs. 11 A-C holotype, pl. 2, figs. 15 A-B = *Vaginula obscura* from Congo, Prov. Stanleyville, Distr. Kibali Ituri, Undussumu  $1^{\circ} 30' \text{N } 32^{\circ} 20' \text{E}$ .—Simroth 1912: pl. 4, figs. 6 A-B = *Vaginula insularis* from Tanganyika, Distr. Bukoba, Bussiro Isle.—Connolly 1939: pl. 15, fig. 19 = *Veronicella obscura* (?) from Rhodesia, Victoria Falls.—Forcart 1953: pl. 2, figs. 11 a-c.

**Body measurements:** Forcart 1953: 81, tab. 20.

**Anatomy:** Simroth 1896a: 19, pl. 3, figs. 7 C-E = *Vaginula decipiens* from Swosse Island in Lake Victoria.—Simroth 1912: 48, pl. 4, figs. 6 C-F = *Vaginula insularis* from Bussiro Island, Lake Victoria.—Robson 1914: 266-268, figs. 1-2 = *Veronicella nilotica* from the Sudan above Khartoum.—Forcart 1953: 83, pl. 5, figs. 3 a-d.



Figs. 10, 11. (10) *Apera gibbonsi* (Binney). (11) *Apera rubella* Watson. Representative teeth from the radula (after Watson). C = central tooth.

*Distribution:* *Laevicaulis striatus* has the greatest African distribution in the genus, reaching from Lake Chad and the Sudan in the north to Rhodesia in the south, and from the Congo, Province Leopoldville, in the west to Lake Victoria and Rhodesia in the east, with its distribution centre in the Central African Lake Region (cf. Forcart 1953: 82, map 9).

*Localities:* Rhodesia: Victoria Falls in Rain Forest, under log, leg. A. C. & W. H. van Bruggen 28.X.1963. Connolly (1939: 452 = *Veronicella obscura*).

## II. Family *APERIDAE* Moellendorff

Aperidae Moellendorff, 1902. In Martini & Chemnitz, Conch. Cab., 1 (12B): 5.

Most species of the probably subterranean Aperidae are extremely rare, only one or a few specimens of most species being known.

### Genus *Apera* Heynemann, 1885

*Apera* Heynemann, 1885. Jb. deutsch. malak. Ges., 12: 20. Nom. nov. for *Chlamydephorus* Binney, 1879. Typespecies: *Chlamydephorus gibbonsi* Binney, 1879.—Forcart 1963, Proc. Malac. Soc. Lond. 35 (2/3): 108, with synonymy.

#### Key to the species

1. Body with longitudinal keels (figs. 1-4) . . . . . 2
- Body without longitudinal keels (figs. 5-9) . . . . . 4
2. (1.) Body with four longitudinal keels, two on each side (fig. 1) . . . . . 3
- Body with six longitudinal keels, three on each side (fig. 2) . . ***Apera lawrencei***
3. (2.) Upper keels gradually converging behind respiratory opening, uniting to a single short median keel at the posterior end of the body (fig. 3) . . . . .
- . . . . . ***Apera sexangula***
- Upper keels in the posterior  $\frac{3}{8}$  of the body-length very prominent, at first diverging and then curving round to meet in a very obtuse angle above the posterior extremity of the foot, without median keel (fig. 4) . . . ***Apera burnupi***
4. (1.) Dorsal grooves not united in front of the respiratory opening (fig. 6) . . . 5
- Dorsal grooves united to a medium groove in front of the respiratory opening (fig. 7) . . . . . 6
5. (4.) Anterior radial grooves branch from respiratory orifice separately from the dorsal grooves (fig. 14a) . . . . . ***Apera bruggeni* sp.n.**
- Anterior radial grooves branch from dorsal grooves near the respiratory orifice (fig. 6) . . . . . ***Apera purcelli***
6. (4.) Dorsal grooves unite into a single median groove about the middle of the body (fig. 16a) . . . . . ***Apera watsoni* sp. n.**
- Dorsal grooves unite into a median groove in the last third of the body (fig. 7) . . . . . 7
7. (6.) Dorsal grooves unite into a median groove at less than 2 mm from respiratory orifice (fig. 18a) . . . . . ***Apera septentrionalis* sp. n.**
- Junction of dorsal grooves into a medium groove more than 2 mm from the respiratory orifice (fig. 7) . . . . . 8

- |     |       |   |                       |
|-----|-------|---|-----------------------|
| 8.  | (7.)  | Upper limits of lowest row of rugae form an irregular groove, parallel to the peripodial groove (fig. 8) .. .. .                    | <b>Apera dimidia</b>  |
| —   |       | No groove parallel to the peripodial groove (fig. 5) .. .. .  | 9                     |
| 9.  | (8.)  | Four radial grooves diverging on each side of the respiratory orifice (fig. 7) .. 10  |                       |
| —   |       | Three radial grooves diverging on each side of the respiratory orifice (fig. 9) ..  |                       |
|     |       | .. .. .   | <b>Apera parva</b>    |
| 10. | (9.)  | Central tooth of radula well developed (fig. 10). Penis relatively short, penial retractor as long as penis (fig. 12) .. .. .       | <b>Apera gibbonsi</b> |
| —   |       | Central tooth of radula absent or vestigial (fig. 11). Penis relatively long, penial retractor shorter than penis (fig. 13) .. .. . | 11                    |
| 11. | (10.) | Animal stout, tapering abruptly at the hind end .. .. .   | <b>Apera rubella</b>  |
| —   |       | Animal very slender, tapering to a very acute angle at the hind end .. .. .   | <b>Apera gracilis</b> |

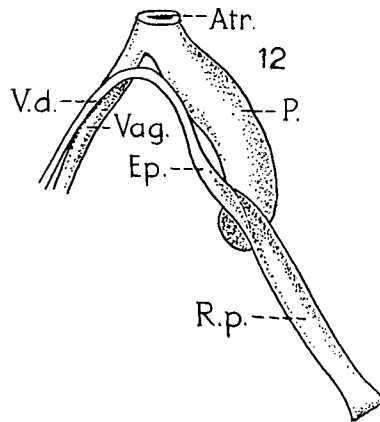


Fig. 12. *Apera gibbonsi* (Binney), male reproductive organs (after Watson). Explanation of abbreviations on p. 509.

#### *Apera purcelli* Collinge

*Apera purcelli* Collinge, 1901. Fig. 6. Ann. S. Afr. Mus., 2: 230. Type-locality: Cape Province, Table Mountain. Holotype in S. Afr. Mus.—Watson 1915, Ann. Natal Mus., 3 (2): 207-210, with synonymy.—Connolly 1939, Ann. S. Afr. Mus., 33:10.

No specimens seen.

*Habitus illustrations:* Colling 1901: pl. 14, figs. 1, 2.—Watson 1915: pl. 8, fig. 25.

*External characters* (Fig. 6): Colling 1901: 230.—Watson 1915: 208.—Connolly 1939: 10.

*Shell:* Watson 1915: 209, pl. 13, figs. 47, 48.

*Anatomy:* Watson 1915: 209; pl. 13, fig. 55; radula p. 161, fig. 4C.

*Distribution:* Only known from the type-locality.

#### *Apera bruggeni* n. sp. Figs. 14-15

Holotype in Natal Museum, Pietermaritzburg.

*Type-locality:* Transvaal, Kruger National Park, Olifantspoort area.

*Etymology:* *Apera bruggeni* is dedicated to Dr. A. C. van Bruggen.

*Diagnosis:* *Apera bruggeni* resembles *Apera purcelli* in its external characters. It differs from the description of that species as given by Watson (1915: 207-210), in its greater size, in the anterior radial grooves, branching from the respiratory opening apart from the dorsal grooves, and in the presence of lateral grooves.

*External Characters* (Figs. 14a, b): Animal elongate, tapering to a blunt point at the hind end. Dorsum rounded without keels. Outer lip of respiratory opening narrow, exposing the inner lip. Skin with a well-marked reticulation. Dorsal grooves separated on the head partly by a double row, on the remaining part of the body by a single row of rugae. The holotype has on its left side, behind the respiratory orifice, cicatricial tissue with irregular grooves. At the right side three well-developed radial grooves branch from the respiratory orifice. The first radial groove branches into lateral grooves, extending proximally parallel to the dorsal grooves, and into sublateral grooves. This branching is different on both sides of the body. The second and third radial grooves extend down to the peripodial groove.

*Colour:* Body dark gray with a lighter median strip between the dorsal grooves. Foot yellowish-white.

*Body measurements:*

Length	.. .. .	30	mm
Breadth in middle	.. .. .	5	mm
Breadth at respiratory orifice	.. .. .	4.5	mm
Breadth of foot sole	.. .. .	3.5	mm
Height in middle	.. .. .	5	mm
Distance from respiratory opening to hind end	..	2.8	mm
Distance between dorsal grooves			
on head	.. .. .	0.7	mm
in middle of body	.. .. .	0.4	mm

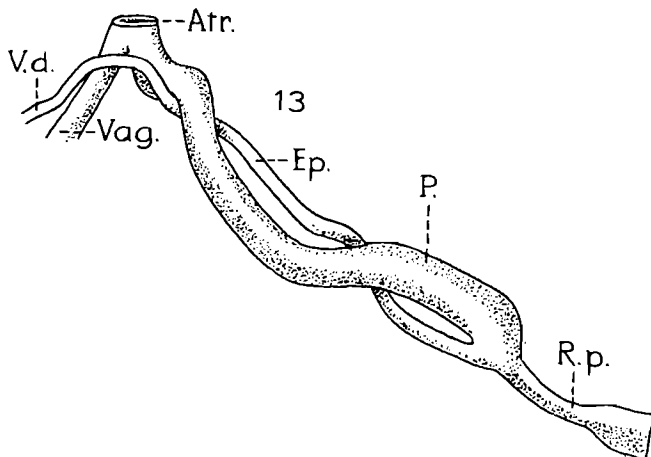


Fig. 13. *Apera rubella* Watson, male reproductive organs (after Watson). Explanation of abbreviations on p. 509.

**Reproductive System** (fig. 15): The holotype is probably mature, but has not yet copulated. The distally pointed albumen gland has approximately the same length as the ovispermiduct. The vagina and pediculus of the receptaculum seminis form a jointed duct, swollen towards the genital opening and tapering posteriorly. The uterus is inserted laterally to this jointed duct. The bursa of the receptaculum seminis is elongated. The penis is a little shorter than the vagina + receptaculum seminis. The distal end of the epiphallus is swollen as is the vas deferens at its branching from the ovispermiduct. The penial retractor is thin and longer than the penis.

**Pedal gland:** The pedal gland is glandular throughout its entire length; its last part before the vesicula is thinner.

**Affinities:** *Apera bruggeni* belongs to the group of *Apera purcelli* and *dimidiata*, being more closely related to the former.

**Distribution and habitat:** *Apera bruggeni* is only known from its type-locality in the Transvaal, Kruger National Park, block C 3, Olifantspoort area, under a stone, leg. Biologist, Kruger National Park, 6.XII.1962.

**Biology:** The holotype was found devouring a *Sphaerotherium* spec. (Diplopoda).

#### ***Apera watsoni* n.sp. Figs. 16-17**

Holotype and two Paratypes in the Natal Museum, Pietermaritzburg.

**Type-locality:** Transvaal, Kruger National Park, block C 162, Sabi River area.

**Etymology:** *Apera watsoni* is dedicated to the late Hugh Watson, M.A., author of the monograph on Aperiidae.

**Diagnosis:** A slender, small species with two dorsal grooves uniting in the anterior half of the dorsum to a single median groove.

**External Characters** (figs. 16a, b): Animal slender, tapering to an acute angle at the hind end. Back rounded without keels. Outer lip of respiratory opening narrow, exposing the inner lip. Dorsal grooves separated by a single row of rugae, uniting into a single median groove before the middle of the body. Lateral grooves parallel to dorsal grooves, ending near the mouth-opening. A median posterior groove diverging backwards from the orifice. In the holotype and one paratype there are three radial grooves on each side. In one paratype a fourth pair of radial grooves is diverging from the median posterior groove 0.3 mm behind the orifice. The first radial grooves branch into lateral grooves and posterior oblique sub-lateral grooves. The distance between these bifurcations and the orifice is variable. In the holotype it is 3 mm on the right and 0.7 mm on the left side; in one paratype 4.5 mm and 3.5 mm, and in the other paratype 0.6 mm and 2.6 mm. The first and second radial grooves diverge separately from the orifice; in the paratypes they start on the right side separated and at the left side united, forming an acute angle. All radial grooves reach the peripodial groove.

**Colour:** Body gray, foot-sole yellowish white. Dr. A. C. van Bruggen has noted that the colour has changed little after killing by suffocation in water and preservation in alcohol.



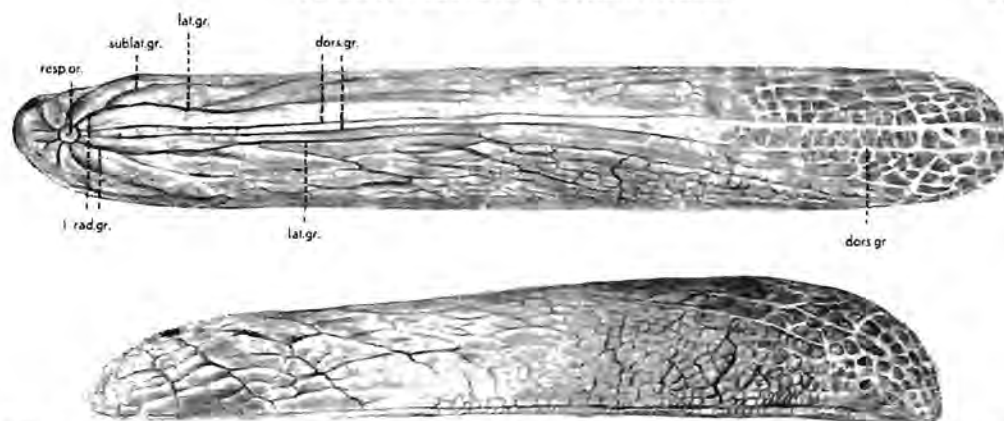


Fig. 14. *Apera bruggeni* n.sp., holotype from the Transvaal, Kruger National Park, Olifantspoort area. Dorsal and lateral views,  $\times 4.5$ . dors. gr. = dorsal grooves. lat. gr. = lateral grooves, resp. or = respiratory orifice. sublat. gr. sublateral groove. 1 rad. gr. = first radial groove.

*Body measurements:*

	Holotype	Paratypes	
	mm	mm	mm
Length . . . . .	26	27	23.5
Breadth in middle . . . . .	3.3	3.4	2.7
Breadth at respiratory opening . . . . .	3	3.2	2
Breadth of foot-sole . . . . .	1.3	1.6	1.3
Height in middle . . . . .	3.1	3	3
Distance from respiratory opening to hind end . . . . .	6.5	6	5.6
Distance between dorsal grooves on head . . . . .	0.4	0.4	0.5
Distance from fusion of dorsal grooves to respiratory opening . . . . .	13	13.6	11

*Reproductive System* (fig. 17): The dissected paratype of 27 mm is immature. The reproductive system is much like that of *Apera dimidia*. The albumen gland is oblong, longer than the ovispermiduct. The latter is rather short and curved. Uterus and vagina are of about the same length. The vagina and the pediculus of the receptaculum seminis form a jointed duct, into which the uterus inserts laterally. The spherical bursa of the receptaculum seminis is small (juvenile?). The receptaculum seminis is attached to the adjacent tissue by fine muscles. The penis is oblong and the epiphallus of the same diameter than the vas deferens. The penial retractor is long, narrow, a little broader before its insertion at the penis.

*Pedal gland:* The pedal gland is glandular throughout, and has the same shape as that of *Apera purcelli* (cf. Watson 1915: pl. 13, fig. 55).

*Affinities:* *Apera watsoni* belongs, as *Apera bruggeni* n.sp. does, to the group of *Apera purcelli* and *dimidia*.

*Distribution and habitat:* *Apera watsoni* is so far known only from its type-locality in the Transvaal, Kruger National Park, Sabi River area, block C 162 where it was found by A. C. van Bruggen on 26.IV.1962 under old logs and in leaf mould.

*Apera dimidia* Watson. Fig. 8

*Apera dimidia* Watson, 1915. Ann. Natal Mus., 3 (2): 204-207. Holotype in Brit. Mus. London n° 1914.1.7.248. Type-locality: Natal, Equeefa farm on the Umzinto River 3 miles SW Umzinto (S.P. Dance of the Brit. Mus. in lit.: "We have a specimen labelled 'Holotype'. The locality given on the same label is 'Port Shepstone, Natal'. But in the tube with the specimen is a pencilled label which reads '*Apera* sp. Equeefa' (the label is probably in Connolly's writing but I am not sure of this). I consider the pencilled label to be correct. Therefore Watson's type locality is correct."—Connolly 1939, Ann. S. Afr. Mus., 33: 9-10. (Connolly (1939: 10) did not notice the type-designation of Watson (1915: 259), and by error designated the specimen from Port Shepstone as lectotype).

No specimens seen.

*Habitus illustrations* (fig. 8): Watson 1915: pl. 7, figs. 7-9, pl. 8, figs. 20, 21, 24.

*External characters*: Watson 1915: 204-206.

*Shell*: Watson 1915: 206, pl. 13, fig. 46.

*Anatomy*: Watson 1915: 206-207, pl. 9, fig. 29, pl. 11, fig. 34, pl. 12, figs. 36-39, pl. 13, fig. 40. Pedal gland and nervous system pl. 13, figs. 54, 59-62, pl. 14, fig. 69, pl. 15, figs. 71, 73, 75. Tentacle and eye pl. 16, figs. 80-86. Odontophore and radula p. 161, fig. 4B, pl. 16, figs. 88-90, pl. 17, figs. 105-107, pl. 18, figs. 115-122, pl. 20, fig. 127. Digestive system pl. 21, fig. 132, pl. 22, figs. 136-137. Reproductive organs pl. 23, fig. 147. Spermatozoon pl. 23, fig. 151.

*Distribution*: *Apera dimidia* is known in Natal from Pietermaritzburg south to Port Shepstone.

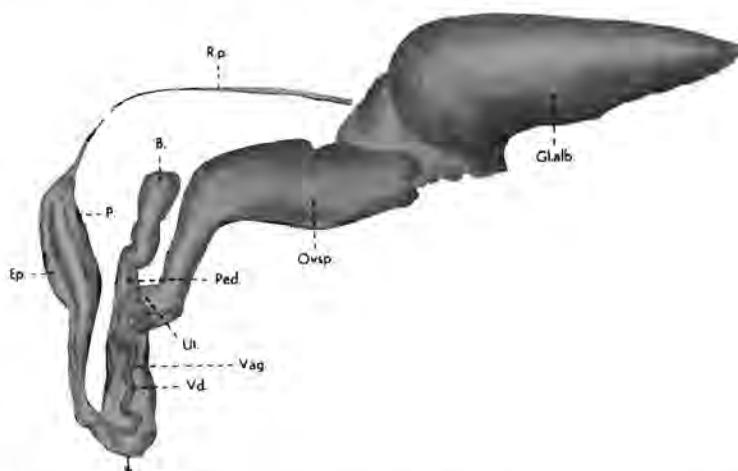


Fig. 15. *Apera bruggeni* n.sp., holotype reproductive organs. Explanation of abbreviations on p. 509.

*Apera rubella* Watson. Figs. 5, 7, 11, 13

*Apera gibbonsi rubella* Watson, 1915. Ann. Natal Mus., 3 (2): 197-199. Holotype in Natal Mus. Cat. No. 4185, Type No. 606 (dissected). Two paratypes in Natal Mus. No. 4181, Type No. 608, 1 ad., 1 juv. Type-locality: Natal, Equeefa farm on the Umzinto River, 3 miles SW Umzinto.—Connolly 1939, Ann. S. Afr. Mus., 33: 7-8.

*Apera gibbonsi lupata* Watson, 1915. Op. cit.: 200-201. Holotype and one paratype in Natal Mus.

Cat. No. 4186, Type No 604 (A. C. van Bruggen noted in litt. that one specimen is  $\pm$  less than 40 mm, and one  $\pm$  more than 40 mm in length). As Watson (1915: 200) mentioned a body length of 46 mm, the latter specimen is the holotype. Type-locality: Natal, Port Shepstone.—Connolly 1939, op. cit.: 8.

*Apera gibbonsi lupata* var. *duplex* Watson, 1915. Op cit.: 201-202. Holotype in Natal Mus. Cat. No. 4183, Type No 603. Type-locality: Cape Prov., Port St. Johns.—Connolly 1939, Op. cit.: 8.

*Apera rubella* Watson.—Forcart 1963, Proc. Malac. Soc. Lond. 35 (2/3): 108.

*Apera gibbonsi*.—Forcart 1963, op. cit.: 108 partim.

*Apera dimidiata* (sic!)—Forcart 1963, op. cit.: 109.

*Taxonomic notes:* The external characters of *Apera rubella* and *gibbonsi* are so much alike that it is often impossible to distinguish them without dissection. They differ in their radulae, *Apera rubella* having no or only a vestigial (cf. radula of var. *duplex*, Watson 1915: 201) central tooth, and by their penis, which is long and twisted with a relatively short retractor in *Apera rubella*, and relatively short and distally curved with a long retractor in *Apera gibbonsi*. Watson's descriptions of the mentioned subspecies and variety have been partly based on the variability of the external characters and of the radula. A re-examination of specimens mentioned by Forcart (1963: 108, 109) as *Apera gibbonsi* and *dimidiata* (sic!) resulted in these now being recognised as *Apera rubella*.

*Habitus illustrations* (figs. 5, 7): Watson 1915: pl. 7, figs. 3-4, pl. 8, figs. 16-17 typical form; pl. 7, fig. 6, *gracilis* form; pl. 8, figs. 18-19, *lupata* form.

*External Characters:* Watson 1915: 197, 199-201.

*Live colour* (as noted by van Bruggen): One orange-red and one bluish-gray, both from Zululand, Hluhluwe Game Reserve.

*Shell:* Watson 1915: 199-200, pl. 13, figs. 41-43.

*Anatomy* (fig. 13): Watson 1915: 198, pl. 9, fig. 27, pl. 13, fig. 52, pedal gland pl. 14, figs. 63-65, ventral nerve ganglion pl. 14, fig. 67, digestive system pl. 21, fig. 130, reproductive organs pl. 23, figs. 144, 145.

*Radula* (fig. 11): Watson 1915: 198, p. 159, fig. 3B, pl. 20, fig. 126 typical form; p. 199, p. 159, fig. 3C, pl. 19, fig. 123 *gracilis* form; p. 200-201, p. 159, fig. 3D, pl. 19, fig. 124 *lupata* form; p. 159, fig. 3E *duplex* form.

*Distribution:* The known range of *Apera rubella* extends from Zululand (Hluhluwe Game Reserve) to Pondoland (Port St. Johns), and from the coast inland to Pietermaritzburg.

*Localities:* Zululand: Hluhluwe Game Reserve near Crocodile Pool, in long grass, leg. Mrs. W. H. van Bruggen 27.XI.1962; central area near pool on edge of road N Hlaza River, under log, leg. A. C. van Bruggen 26.XI.1962; without exact locality (Forcart 1963: 108 = *Apera gibbonsi*). Natal: Pietermaritzburg and Scottsville (not Scottsborough). (Forcart 1963: 108 = *A. gibbonsi*, p. 109 = *A. dimidiata* (sic!).—St. Helier near Pinetown (Forcart 1963: 108.—Durban (Watson 1915: 198).—Equeefa farm near Umzinto (type-locality of *A. gibbonsi rubella*, Watson 1915: 198). Port Shepstone (type-locality of *A. gibbonsi lupata*, Watson 1915: 201). Cape Province, Pondoland: Port St. Johns (type-locality of *A. gibbonsi lupata* var. *duplex*, Watson 1915: 201).

### *Apera gracilis* Watson

*Apera gibbonsi gracilis* Watson, 1915. Ann. Natal Mus., 3 (2): 199-200. Holotype in Natal Mus. Cat. No 4187, Type No 605. Type-locality: Natal, Equeefa farm on the Umzinto River, 3 miles SW Umzinto.—Connolly 1939, Ann. S. Afr. Mus., 33: 8.

*Taxonomic notes:* Two specimens only of *Apera gracilis* are known, the holotype and a specimen found by Lawrence in 1966 at Ifafa. *Apera rubella* has been found at the same localities. Both species agree in radula and reproductive organs, but differ in size and form. *Apera gracilis* is mature at about 23 mm, very slender, and tapering to a very acute angle at the hind end. *Apera rubella* and *A. gracilis* are sympatric species.

*Habitus illustration:* Watson 1915: pl. 7, fig. 6.

*External Characters:* Watson 1915: 199.

*Measurements of the specimen from Ifafa:*

Length .. .. .	23.6 mm.
Breadth in middle .. .. .	4.5 mm
Breadth of respiratory opening .. .. .	3.4 mm
Breadth of footsole .. .. .	3 mm
Greatest height .. .. .	4.8 mm
Distance of respiratory opening from hind end .. .	5.6 mm

*Shell:* Watson 1915: 199, pl. 13, fig. 43.

*Anatomy:* Watson 1915. The mature reproductive organs of the specimen from Ifafa agree with those of *Apera rubella*. The bursa of the receptaculum seminis contains spermatozoa, and the penis a parasite (nematode?) over its whole length.

*Habitat and Distribution:* Natal, Equeefa (Watson 1915: 199, type locality); South Coast, Ifafa, in leaf mould on the floor of coastal bush, leg. R. F. Lawrence X.1966.

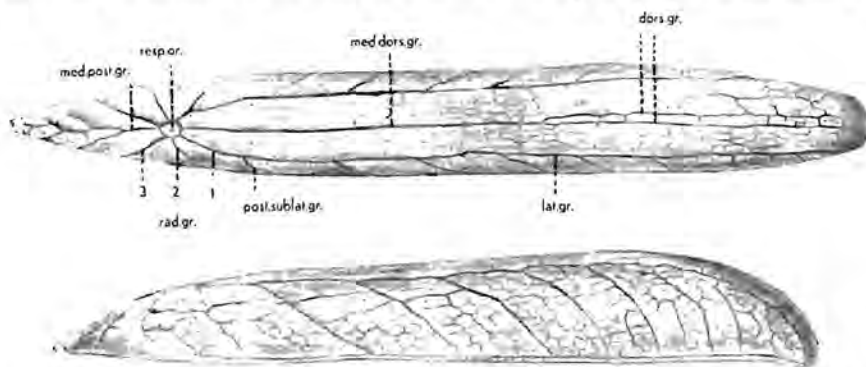


Fig. 16. *Apera watsoni* n.sp., holotype from the Transvaal, Kruger National Park, block C 162, Sabi River area. Dorsal and lateral views, x4.5. dors. gr. = dorsal grooves. lat. gr. = lateral groove. med. dors. gr. = median dorsal groove. post. sublat. gr. = posterior sublateral groove. resp. or. = respiratory orifice. 1-3 rad. gr. = first to third radial grooves.

#### *Apera gibbonsi* (Binney). Figs. 10, 12

*Chlamydephorus gibbonsi* Binney, 1879. Bull. Mus. Comp. Zool. Harvard, 5: 331, pl. 2 figs. A, B. Holotype in Acad. nat. Sci. Philadelphia, a shell fragment (cf. Baker 1963: 221). Type-locality: Natal, Umgeni (not Ungeni) valley.

*Apera gibbonsi* (Binney).—Watson 1915, Ann. Natal Mus., 3 (2): 192-197 with synonymy.—Connolly 1939, Ann. S. Afr. Mus., 33: 7.—Forcart 1963, Proc. Mal. Soc. Lond., 35 (2/3): 108 partim.

*Apera rubella*.—Forcart 1963, op. cit.: 108 partim.

*Habitus illustrations:* Binney 1879: pl. 2, fig. 1A. Watson 1915: pl. 7, figs. 1-2, pl. 8, figs. 14-15.

*External Characters:* Binney 1879: 331-332, description of a living specimen.—Watson 1915: 194-195.

*Shell:* Watson 1915: 195.

*Anatomy* (fig. 12): Watson 1915: 195-196, odontophore pl. 17, figs. 91, 92; digestive system pl. 21, fig. 129; reproductive system pl. 23, fig. 143.

*Radula* (fig. 10): Binney 1879: 332, pl. 2, fig. B.—Watson 1915: 195, 159 fig. 3A, pl. 20, fig. 125.

*Distribution:* The range extends from Zululand to Pondoland, like that of *A. rubella*.

*Localities:* Zululand: Hlabisa (Watson 1915: 196).—On the White Umfolosi River, under stones, leg. H. W. Bell-Marley 27.VII.1927.—Richards Bay, leg. R. F. Lawrence XII.1943.—Ngoye Forest near Eshowe (Forcart 1963: 108 = *Apera rubella*).—Middledrift on the Tugela River (Forcart 1963: 108). Natal: Kranskop, leg.—R. F. Lawrence XI.1954 and in indigenous forest, leg. A. C. & W. H. van Bruggen 28.XI.1963 (one newly hatched young).—Umgeni Valley, type-locality of *Apera gibbonsi*.—Pietermaritzburg (Watson 1915: 196). Cape Prov., Pondoland: Port St. Johns (Forcart 1963: 108).

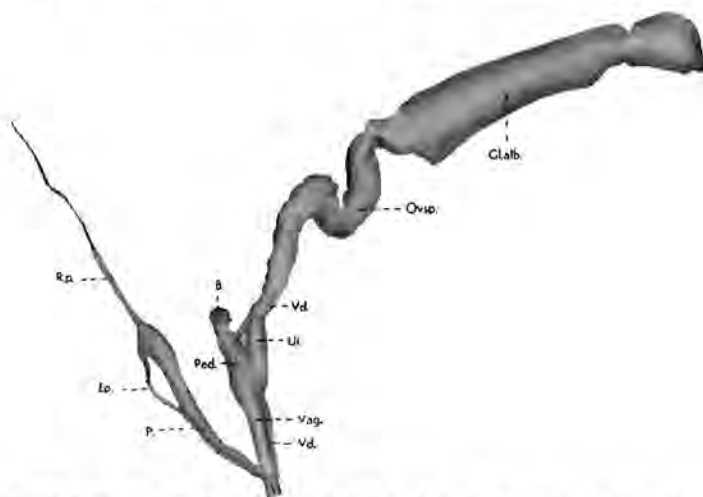


Fig. 17. *Apera watsoni* n.sp., paratype from the Transvaal, Kruger National Park, block C 162, Sabi River area. Reproductive organs. Explanation of abbreviations on p. 509.

#### *Apera septentrionalis* n.sp. Figs. 18-19

Holotype and one Paratype in Natal Museum, Pietermaritzburg.

*Type-locality:* Rhodesia, Mount Vumba, Laurenceville.

*Diagnosis:* A small species, mature at about 20 mm. External characters much like juvenile *Apera gibbonsi*, differing in specimens of equal size by the more distant dorsal grooves, the shorter distance of their fusion from the respiratory opening, and the respiratory opening, situated nearer to the hind end of the body.

*External Characters* (figs. 18 a, b): Animal slightly swollen towards the middle, not as acutely tapering at the hind end as in *Apera gibbonsi*. The tip of the tail ( $\pm 2$  mm) is absent in the paratype, probably bitten off, partly with cicatricial tissue. Dorsum rounded without keels. Outer lip of respiratory orifice narrow in the holotype, exposing the inner lip. In the paratype the outer lip is almost concealing the inner lip. The median posterior groove branches in the holotype into two grooves on the right and one groove at the left side. It diverges 2.7 mm posterior the orifice. Three radial grooves diverge on each side of the orifice. Oblique sublateral grooves branch out of the most anterior radial grooves.

*Colouring*: The ground-colour of the holotype is yellowish-white, of the paratype mustard-brown. The back has a greyish tinge, darkest on the sublateral grooves. The paratype has a lighter strip between the dorsal grooves.

*Body measurements:*

	<i>Holotype</i> mm	<i>Paratype</i> mm
Length .. .. .	21.7	15.5 + x
Breadth in middle .. .. .	5.3	4.8
Breadth at respiratory opening .. .. .	3.4	3.5
Breadth of foot-sole .. .. .	2.2	1.8
Height in middle .. .. .	5	4.5
Distance from respiratory opening to hind end ..	4.3	3.2 + x
Distance between dorsal grooves		
on head .. .. .	0.6	0.4
in middle .. .. .	0.4	0.5
Distance from fusion of dorsal grooves to respiratory opening .. .. .	1.7	1.3

*Reproductive System* (fig. 19): The albumen gland is relatively short, tricuspid. The ovispermiduct is also short, curving as in *Apera gibbonsi*. The uterus is much shorter than the swollen vagina. The receptaculum seminis consists of a very short pediculus and an elongated bursa. The penis is elongate, the epiphallus and vas deferens are like those of *Apera rubella*. The penial retractor is short and broad, forming a muscular sheath at the distal penial end with a branch running to the proximal end of the epiphallus.

*Pedal gland*: Slender, glandular tissue diminishing behind middle of gland, similar to the pedal gland of *Apera parva* (Watson 1915: 203, pl. 13, fig. 53).

*Affinities*: *Apera septentrionalis* belongs to the group of *Apera gibbonsi*, *rubella*, and *parva*.

*Distribution*: *Apera septentrionalis* lives in the highlands of south-eastern Rhodesia.

*Localities*: Rhodesia. Mount Vumba, Laurenceville, 1300 m to 1650 m alt., leg. D. M. & A. J. Cookson XII.1963, type-locality;—Mount Selinda, Chirinda Forest, 1070 m alt., leg. B. R. Stuckenberg, I.1955.

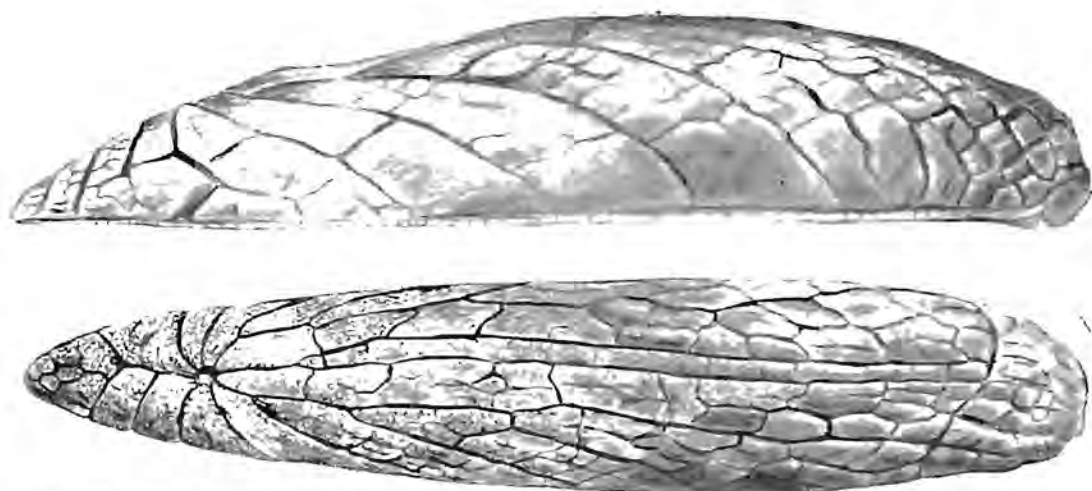


Fig. 18. *Apera septentrionalis* n.sp., holotype from Rhodesia, Vumba mountains, Laurenceville. Dorsal and lateral views, x6.75.

*Apera parva* Watson. Fig. 9

*Apera parva* Watson, 1915, Ann. Natal Mus., 3 (2): 202-204. Holotype in Natal Museum Pietermaritzburg, cat. no 4184, type n° 607. Type-locality: Cape Prov. near Fern Kloof  $\pm$  3 miles S Grahamstown.—Forcart 1963, Proc. Malac. Soc. Lond., 35 (2/3): 109.

*Habitus Illustrations* (fig. 9): Collinge 1901: pl. 14, figs. 1-2—Watson 1915: pl. 8, figs. 22-23.

*External Characters*: Collinge 1901: 230.—Watson 1915: 202.—Forcart 1963: 109.

*Anatomy*: Watson 1915: 203-204; general dissection pl. 9, fig. 28; pedal gland pl. 13, fig. 53; digestive system pl. 17, figs. 100-102, pl. 21, fig. 131; radula p. 161, fig. 4A; reproductive system pl. 23, fig. 146.

*Distribution*: *Apera parva* is known from only the district of Grahamstown, Cape Province.

*Localities*: Cape Province near Fernkloof about three miles south of Grahamstown, type-locality (Watson 1915: 204).—Port Alfred (Forcart 1963: 109).

*Apera burnupi* Smith. Fig. 1, 4

*Apera burnupi* Smith, 1892, Ann. Mag. nat. Hist., (6) 10: 466. Holotype in Brit. Mus. London, n° 1892.11.16.103. Type-locality: Natal, environs of Pietermaritzburg.—Watson 1915, Ann. Natal Mus., 3 (2): 210-213 with synonymy.—Connolly 1939, Ann. S. Afr. Mus., 33: 10-11.—Forcart 1963, Proc. Malac. Soc. Lond., 35 (2/3): 109.

*Apera natalensis* Collinge, 1900, Ann. S. Afr. Mus., 2: 3, Holotype in South African Museum, Cape Town. Type-locality: Natal, Richmond.

*Habitus Illustrations* (fig. 1, 4): Collinge 1900: pl. 1, figs. 3, 4; reproduced by Simroth 1909 in Bronn "Klassen und Ordnungen des Tier-Reichs", 3: pl. 4, figs. 9, 10 = *Apera natalensis*.—Watson 1915: pl. 7, figs. 12, 13.



*External Characters:* Watson 1915: 214-215. The large flattened oval area between the posterior three-eighths of the upper keels, typical for adult *Apera burnupi*, is much narrower in juveniles, being much like that area in *Apera sexangula*, in which they differ by the upper keels meeting in an obtuse angle without median keel.

*Shell:* Watson 1915: 212, pl. 13, fig. 49.

*Anatomy:* Collinge 1900: 3-5, pl. 2, figs. 14, 15.—Watson 1915: 212-213; pedal gland pl. 13, fig. 56; odontophore pl. 17, figs. 108, 109; radula pl. 20 fig. 128, p. 161, fig. 4 D; digestive system pl. 21, fig. 133; reproductive organs pl. 23, fig. 148.

*Distribution:* The distribution extends from Natal (29°S 30° 25'E) to the Cape Province (32° 36'S 26° 30'E).

*Localities:* Natal: Champagne Castle Hotel (Forcart 1963: 109). Pietermaritzburg, type locality of *Apera burnupi* (Smith 1892: 466, Watson 1915: 213).—Bulwer, leg. A. Alexander.—Richmond, type locality of *Apera natalensis* (Collinge 1900: 3-5. Watson 1915: 213), leg. R. F. Lawrence VII.1946 (Forcart 1963: 109). Cape Province: Port St. Johns and Ngeli Forest near Kokstad (Forcart 1963: 109).—Kologha Forest near Stutterheim, 3000-4000 ft. alt., leg. R. F. Lawrence II.1962.—Bosberg slopes, Somerset East, leg. R. F. Lawrence III. 1964.

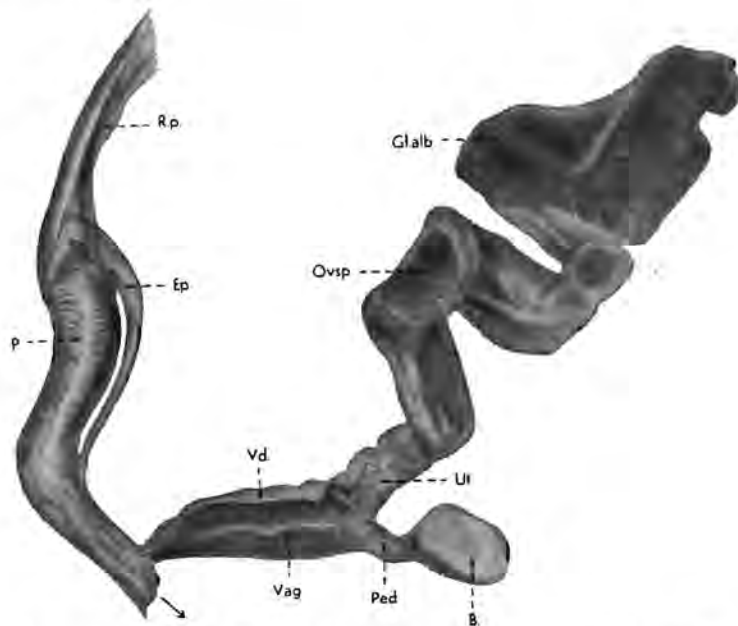


Fig. 19. *Apera septentrionalis* n.sp., paratype from type-locality reproductive organs. Explanation of abbreviations on p. 509.

### *Apera sexangula* Watson. Fig. 3

*Apera sexangula* Watson, 1915. Ann. Natal Mus., 3 (2): 213-217 with synonymy. Holotype in Brit. Mus. (Nat. Hist.) n° 1914.1.7.249.3, paratypes in Natal Mus. cat. n° 4182, type n° 609 (one specimen dissected, the others originals to Watson (1915: pl. 7 figs. 12, 13). Type-locality: Natal, Port Shepstone.—Connolly 1939, Ann. S. Afr. Mus., 33: 11-12.—Forcart 1963, Proc. Malac. Soc. Lond. 35 (2/3): 109.



*Habitus Illustrations:* Collinge 1900: pl. 4, figs. 5, 6.—Watson 1915: pl. 7, figs. 12, 13.

*External Characters* (fig. 3): Watson 1915: 214-215.

*Shell:* Watson 1915: 215-216, pl. 13, figs. 50, 51.

*Anatomy:* Collinge 1897: 221-225 = *Apera burnupi*.—Watson 1915: 215-217; situs viscerum pl. 9, fig. 31; ganglion and pedal gland pl. 13, fig. 57; nervous system pl. 15, fig. 72, 74, 76; mouth pl. 16, fig. 87; odontophore pl. 17, figs. 110-114; radula p. 161, fig. 6 E; digestive system pl. 21, fig. 134, pl. 22, fig. 135; reproductive organs pl. 23, fig. 149.

*Distribution:* The distribution extends from Zululand (27°S) to Grahamstown in the Eastern Cape Province (33° 19'S) in a zone of about 35 miles from the coast of the Indian Ocean.

*Habitat:* Zululand: Ngome forest, leg. R. F. Lawrence XII.1940.—Nkandhla forest, Ngoye forest, Tugela river, Middledrift (Forcart 1963: 109). Natal: Lilani area near Ahrens, leg. R. F. Lawrence VI.1962.—Pietermaritzburg (Watson 1915: 217).—Port Shepstone (Watson 1915: 259).—North Shepstone near Port Shepstone, leg. H. C. Burnup I.1906.

#### *Apera lawrencei* Forcart. Fig. 2

*Apera lawrencei* Forcart, 1963. Proc. Malac. Soc. Lond., 35 (2/3): 109. Holotype in Natal Mus. Type-locality: Transvaal, Barberton.

Only the holotype, which has not been dissected, is known.

*Habitus Illustration* (fig. 2): Forcart 1963: pl. 12, figs. 4 a-d.

*External Characters:* Forcart 1963: 109-110.

*Distribution and Locality:* The species is only known from its type locality, Barberton in the Eastern Transvaal, leg. R. F. Lawrence, III.1960.

#### The Phylogeny of the species of *Apera*

Watson (1915: 217-219) assumed that *Apera purcelli* is the most primitive species of *Apera*, having its nearest relations in the hypothetical, primitive stock from which all recent species have diverged. He distinguished three main branches as having diverged from a primitive stock:

1. Branch with *Apera purcelli* and *dimidia*.
2. Branch with *Apera gibbonsi*, *rubella*, *gracilis* and *parva*.
3. Branch with *Apera burnupi* and *sexangula*.

The newly discovered species confirm Watson's conclusions, not a single one forms a connection between these branches. *Apera bruggeni* and *watsoni* belong to the first branch, *septentrionalis* to the second, and *lawrencei* to the third.

These three evolutionary branches of *Apera* are so closely allied that it seems superfluous to distinguish them as subgenera.

#### Distribution of the Aperiidae

Watson (1915: 193) stated: "The genus *Apera* is only known to inhabit the maritime provinces of South Africa. One species—*A. purcelli*—occurs on the slopes of Table Mountain close to Cape Town; the other forms have only been found in Natal and in the eastern districts of the Cape Province."

The newly discovered species enlarge the known distribution to the north. *Apera lawrencei*, *bruggeni* and *watsoni* live in Transvaal, and *Apera septentrionalis* in Rhodesia.

Only one or a few specimens of most of the smaller species are known. These small, insignificant slugs have probably been overlooked by most collectors of this region; even in well-explored Europe the widely distributed *Boettgerilla vermiformis* Wiktor remained unknown until the middle of the 20th Century.

### III. Family UROCYCLIDAE Simroth

Urocyclidae Simroth, 1889 .Nova Acta acad. Caes. Leop.—Carol., 54 (1): 62.

Verdcourt (1960: 200) wrote in his revision of East African Urocyclidae: "A revision of the African slugs is much needed but could not possibly be carried out with the materials available. Considerable collections of material, particularly topotypes, properly drowned and preserved for dissection purposes are necessary. Studies of the development of the genitalia in single species are needed, since many names have been based on immature individuals. The descriptions and type localities have been so vaguely defined in many cases, that the exact identity of some of the published species will never be ascertained. The anatomy of some of these species has not been illustrated."

The knowledge of the South African Urocyclidae has hitherto been extremely vague. Rich and perfectly preserved new material permitted the clearing up of many misunderstandings. A series of the true *Urocyclus kirkii* Gray, the type-species of the genus *Urocyclus*, is of extraordinary value. This species was only known from its original description, later descriptions of *Urocyclus kirkii* referring to *Urocyclus (Elisolimax) flavescens* (Keferstein).

#### Key to genera and subgenera

1. Male and female ducts inosculate a stimulatory organ (figs. 24, 31) . . . . . Genus **Urocyclus** 2
- Stimulatory organ absent . . . . . 3
2. (1.) Stimulatory organ without apical retractor, containing a gypsobelum (fig. 24) . . . . . Subgenus **Urocyclus** s.str.
- Stimulatory organ with apical retractor, not containing a gypsobelum (fig. 31) . . . . . Subgenus **Elisolimax**
3. (1.) Epiphallian flagellum small, vesicular, much shorter than penial flagellum (figs. 35, 37, 40) . . . . . Genus **Atoxon**
- Epiphallian flagellum longer or as long as penial flagellum (figs. 43, 46) . . . . . 4
4. (3.) A short vagina present. Uterus with glandular portion (fig. 43) . . . . . Genus **Dendrolimax**
- Vagina absent. Uterus and pediculus of receptaculum seminis join at their inosculatation in the atrium. Uterus without glandular portion (fig. 46) . . . . . Genus **Leptichnus**

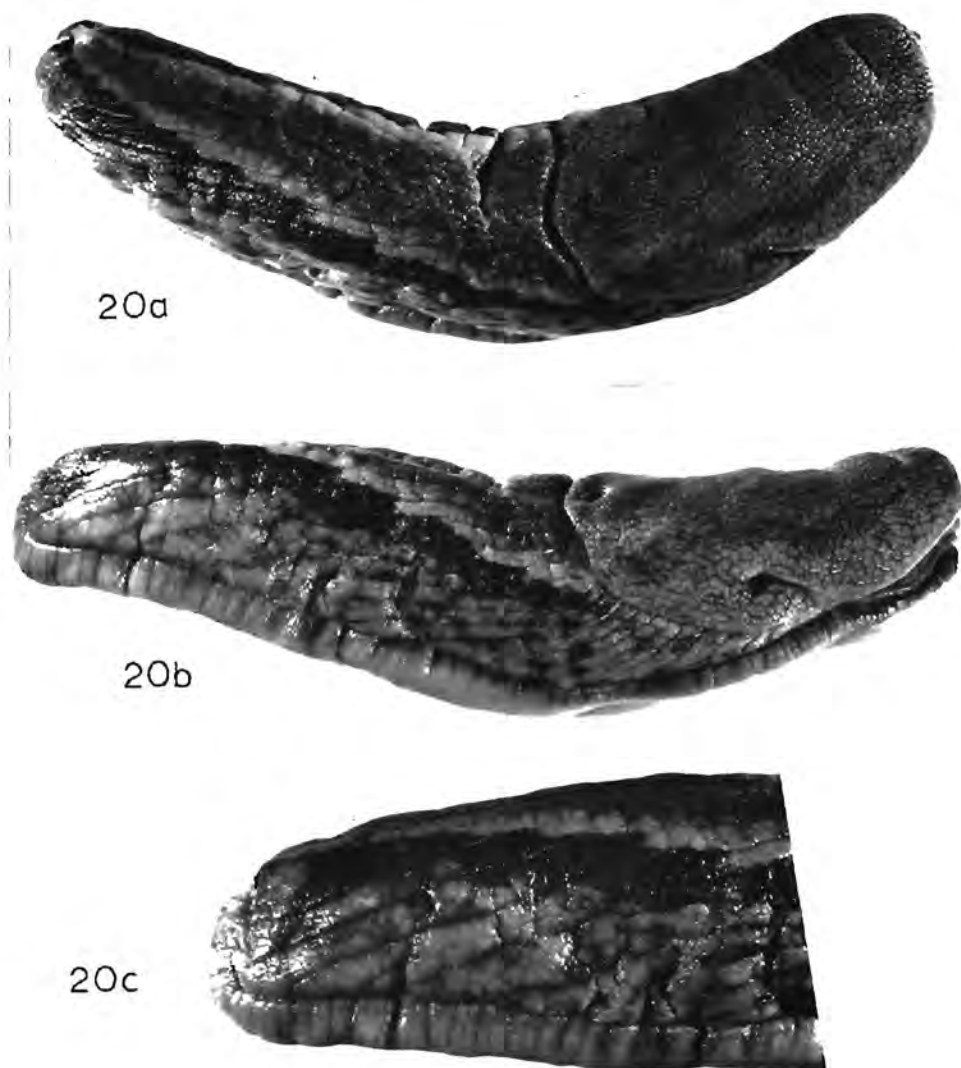


Fig. 20. *Urocyclus (Urocyclus) kirkii* Gray, from Rhodesia, Vumba Circular Drive, Burma Valley, Nyamakari River Causeway. (a) dorsal view, x1.9. (b) lateral view, x1.9. (c) lateral view of hind end, x2.5.

#### Genus *Urocyclus* Gray, 1864

*Urocyclus* Gray, 1864. Proc. Zool. Soc. Lond., 1864: 250. Type-species: *Urocyclus kirkii* Gray, 1864.  
*Spirotoxoxon* Simroth, 1897. Sitz.-Ber. Naturf. Ges. Leipzig, 22/23: 149. Type-species: *Spirotoxoxon elegans* Simroth, 1897.—Pilsbry 1919, Bull. Amer. Mus. nat. Hist., 40: 295.—Verdcourt 1960, J. East Afr. nat. Hist. Soc., 23 (5): 201, and 1961, op. cit. suppl. 7: 30.

The reproductive organs of the true *Urocyclus kirkii* do not have, as hitherto assumed, a stimulatory organ with an apical retractor and without gypsobelum. It has no apical retractor and contains a curved, hollow gypsobelum (fig. 24), as Simroth (1897: 152-153, and 1904: 702-703, pl. 40, figs. 52-55) has described for *Spirotoxox elegans* Simroth, the type-species of the genus *Spirotoxox* Simroth. The generic name *Spirotoxox* Simroth, 1897 is thus synonymous with *Urocyclus* Gray, 1864.

Pilsbry (1919: 295) united *Spirotoxox* Simroth 1897 with *Trichotoxox* Simroth 1889, *Atrichotoxox* Simroth 1910, and *Polytoxox* Simroth 1897 to form a single genus under the oldest name *Trichotoxox*. As *Spirotoxox* is a synonym of *Urocyclus*, the generic name *Trichotoxox* must be replaced by the older name *Urocyclus*.

The group of *Urocyclus flavescens* (Kefenstein), hitherto assumed to belong to *Urocyclus* s.str., has a stimulatory organ differing from that of *Urocyclus kirkii* by its apical retractor and the absence of a gypsobelum. It is referred to *Elisolimax* Cockerell, 1882 with the type-species *Elisa bella* Heynemann 1882, and united with the genus *Urocyclus* as a subgenus.

Two main types of stimulatory organs are distinguished in the family Urocyclidae. In one the male and female excretory ducts inosculate the stimulatory organ as in the genus *Urocyclus* with its subgenera *Urocyclus* s.str., *Polytoxox*, *Trichotoxox*, *Atrichotoxox*, and *Elisolimax*. The stimulatory organ of the second type is a lateral appendix of the atrium, as in the genera *Bukobia* Simroth 1896, *Microcyclus* Simroth 1896, *Mesocyclus* Pollonera 1906 (described as a subgenus of *Urocyclus*), and *Comorina* Simroth 1910.

#### Key to the subgenera of *Urocyclus*

- |    |   |   |
|----|---|---|
| 1. | Stimulatory organ with apical retractor (fig. 31) .. subgenus <b>Elisolimax</b> Cockerell       |   |
| —  | Stimulatory organ without apical retractor (fig. 24) .. .. .                                    | 2 |
| 2. | (1.) Female duct inosculates the stimulation organ at middle or proximal half (fig. 24) .. .. . | 3 |
| —  | Female duct inosculates the stimulation organ near its distal end .. .. .                       | 4 |
| 3. | (2.) A single hollow gypsobelum (fig. 24) .. .. subgenus <b>Urocyclus</b> s.str.                |   |
| —  | Eight or more slender, needle-like gypsobela .. .. subgenus <b>Polytoxox</b> Simroth            |   |
| 4. | (2.) Four to six gypsobela .. .. . subgenus <b>Trichotoxox</b> Simroth                          |   |
| —  | Without gypsobelum .. .. . subgenus <b>Atrichotoxox</b> Simroth                                 |   |

The genus *Urocyclus* is represented by the subgenera *Urocyclus* s.str. and *Elisolimax* in the area considered in this paper.

#### Subgenus *Urocyclus* s.str.

The following species of the subgenus *Urocyclus* s.str. are known:

#### *Urocyclus (Urocyclus) elegans* (Simroth)

*Spirotoxox elegans* Simroth, 1897. Sitz.-Ber. Naturf. Ges. Leipzig, 22/23: 152. Syntypes in Zool. Mus. Berlin. Type-locality: Tanganyika, Bagamojo Distr., Kingani (not Kirgani) River near Dunda  $\pm 6^{\circ}35'S$ ,  $38^{\circ}50'W$ .—Simroth 1904, Zool. Jb. Syst., 19: 702-703, pl. 39 fig. 27 habitus, fig. 27a part of mantle; pl. 40 fig. 51 mandible, figs. 52-55 reproductive organs.—Vercourt 1961, J. East Afr. Nat. Hist. Soc., Suppl. 7: 30.



Fig. 21. *Urocyclus (Urocyclus) kirkii* Gray, from Mozambique, Chiluvo Forest. (a) dorsal view with exposed shell, x2.5. (b) foot-sole, x2.5.

Verdcourt (1961: 30) described this species as keeled, probably by error of translation. Simroth (1897: 152) wrote on the colouring of the back: "Das Mittelfeld ist tiefbraun, mit hellem Kielstreif bis zum Mantel, ebenso hell gegen die Stammbinden abgesetzt." "Kielstreif" does not mean keel, but median stripe on the dorsum.

Simroth described it as a large species, the longest specimen reaching nearly 100 mm.

#### *Urocyclus (Urocyclus) stuhlmanni* (Simroth)

*Spirotoxon* n.sp. Simroth, 1897. Sitz.-Ber. Naturf. Ges. Leipzig, 22/23: 153.

*Spirotoxon stuhlmanni* Simroth, 1904. Zool. Jb. Syst., 19: 704; pl. 39 fig. 28 habitus, fig. 28a sole. Holotype in Zool. Mus. Berlin. Type-locality: East Africa (without further reference), leg. Dr. F. Stuhlmann.

Simroth described an immature specimen, about 53 mm and did not mention a keel. Verdcourt based his description on the figure (Simroth 1904 pl. 39, fig. 28): "with pale brown keel, margined with black". But as is evident from this figure, this species has also no keel, but only a pale brown median stripe on the dorsum.

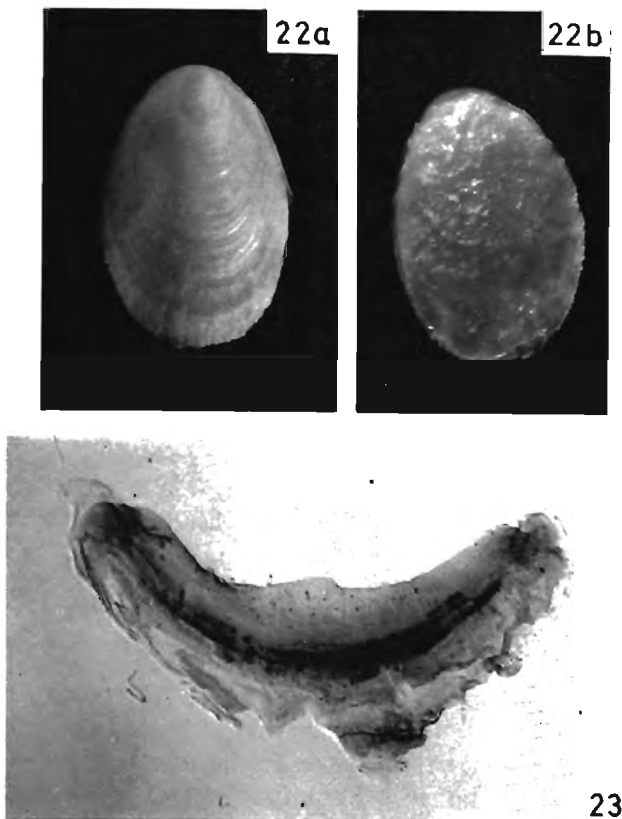
Simroth differentiated his species from *Urocyclus elegans* exclusively on colours. *Urocyclus stuhlmanni* is probably synonymous with *Urocyclus elegans*. The colouring of juveniles of *Urocyclus kirkii* also shows considerable variability.

*Urocyclus (Urocyclus) simrothi* (Verdcourt)

*Spirotoxon* (sic!) *neumanni* Simroth, 1904. Zool. Jb. Syst., **19**: 704; pl. 39 fig. 26 habitus; pl. 40 fig. 26 habitus; pl. 40 fig. 33-34 digestive system, fig. 35 mantle, figs. 36-48 reproductive organs, fig. 49 part of arteria, fig. 50 concretion of mesenchym-cells. Holotype in Zool. Mus. Berlin. Type-locality: Not known. Simroth noted: "Leider nicht sicher angegeben. Wahrscheinlich Soko". Neumann leg.

Simroth described a single specimen of about 46 mm length. In the itinerary and map published by Neumann (1902) no locality "Soko" is marked; probably it is a misspelling for "Doko" in the Eritrean Province Caffa (about 6° 20' N, 36° 30' E), cf. Neumann (1902:22).

In consequence of the subordination of *Spirotoxon* Simroth as a subgenus to *Trichotoxon* Simroth by Pilsbry (1919: 295), *Spirotoxon neumanni* Simroth 1904 became a subjective homonym of *Trichotoxon neumanni* Simroth 1896 (Abh. Senckenberg. Naturf. Ges., **19** (3): 290) and was replaced by the name *Trichotoxon (Spirotoxon) simrothi* Verdcourt 1961. As at present both species are referred to the genus *Urocyclus*, they still remain subjective homonyms.



Figs. 22, 23. *Urocyclus (Urocyclus) kirkii* Gray, from Mozambique, Chiluvo Forest. (22) (a) dorsal, (b) ventral, view of shell, x4.5. (23) Mandible, x15.

All species of the subgenus *Urocyclus* s.str. are closely related, *Urocyclus stuhlmanni* being probably synonymous with *Urocyclus elegans*. Verdcourt (1961: 30) mentioned the relation in length between bursa and pedunculus of the receptaculum seminis as a diagnostic character.

Pedunculus  $\pm 2\text{--}3$  times as long as bursa = *Urocyclus kirkii*.

Pedunculus  $\pm 3\text{--}4$  times as long as bursa = *Urocyclus elegans*.

Pedunculus  $\pm 8$  times as long as bursa = *Urocyclus simrothi*.

*Distribution of the subgenus:* If the problematic type-locality of *Urocyclus simrothi* is indeed "Doko", the distribution of *Urocyclus* s.str. reaches from the south-western montane region of Eritrea to the highlands at the frontier between Mozambique and Rhodesia. This range is split up into different restricted areas: *Urocyclus simrothi* in the province Caffa of Eritrea, *Urocyclus elegans* in the Bagamojo district near the coast of Tanzania, and *Urocyclus kirkii* in the montane frontier between Mozambique and Rhodesia, and—probably transported by drift—at the mouth of the Zambesi River.

### *Urocyclus (Urocyclus) kirkii* Gray. Figs. 20-24

*Urocyclus kirkii* Gray, 1864. Proc. Zool. Soc. Lond. 1864: 251. Holotype in Brit. Mus. London. Type-locality: Mozambique, near the mouth of the River Zambezi on floating weed.—Gray 1865, Ann. Mag. nat. Hist., (3) 15: 332.—Kefirstein 1866, Malak. Bl., 13: 74-75.—Heynemann 1884, Jb. dtsh. Malak. Ges., 11: 3-14.

*Urocyclus kirkei* (sic!)—Semper 1870, Reisen Arch. Philippinen, (2) 3: 11-12.

89 specimens of different age, 78 from Mozambique and 11 from Rhodesia have been examined. They correspond exactly the original description of *Urocyclus kirkii* by Gray (1864: 250-251):

"Body elongate, attached its whole length to the upper surface of the foot. Mantle shield-like, uniformly granular; a small and round deep pit in the middle of the hinder margin. Shell—? Subcaudal gland very large, deep, circular, surrounded by a broad transversely grooved edge. The respiratory aperture on the middle of the right side of the mantle; orifice of generation at the base of the right tentacles. Tentacles four, retractile; lower small."

"Pale brown, with minute square black spots on the sides, with a black streak on each side of the back; middle of the back with two darker brown streaks. The sides of the body with diverging sunken lines. The margin of the foot with a series of small black specks."

*Habitus Illustrations* (fig. 20-21): Gray 1864: 251.—Gray 1865: 332.—Heynemann 1884: pl. 1, figs. 1 a-f.

*External Characters* (figs. 20, 21): A stout slug becoming mature at a length of about 50 mm. Body length of the biggest examined specimen 77 mm. Back not keeled, with partly branched grooves running from the posterior mantle end obliquely backwards to the peripodial groove. Tail with a big orifice of the caudal gland, but without caudal horn. The mantle is weakly shagreened, vaulted at the middle of its posterior end. The size of the shell pore is variable, the slugs being able to open or close it to some extent. Part of the shell is often exposed. The respiratory orifice is near the middle of the body on the right side of the mantle. The sole is tripartite, the central area narrower than the lateral areas.

TABLE 1  
Measurements of *Urocyclus kirkii* Gray

Measurements: (see below)	1 mm	2a mm	2b mm	3 mm	4 mm	5 mm	6a mm	6b mm	7a mm	7b mm	8 mm	9 mm	10 mm	11 mm
Rhodesia														
Vumba Circular Drive .. .. .	77	15.2	14.8	28.9	39.3	1.3	16.3	19.6	17.9	15	2.7	4.8	9.7	1.5
diss. spec. .. .. .	61	10.6	12.6	27.4	27.7	2.6	13.7	18.8	17.1	13.8	2	4	8.1	2.6
Mt. Selinda .. .. .	36.4	7.5	7.4	13.5	19	1.3	7	9.8	8	7.7	2	3	5.5	2
	34.5	7.4	7.2	15.1	18	0.9	8	9.8	10.8	9	1.8	3.3	4.2	1.1
Mozambique														
Chiluvo Forest .. .. .	54.7	11.7	13.1	25.1	27.8	3	13.1	17.2	16	13.1	2.7	5	9.8	2.6
	54.7	11.9	11	22	31.8	2.1	10.8	16.8	13	12.7	2.3	2.8	8.5	1.8
diss. spec. .. .. .	53.6	12	10	19.9	32.9	2.7	10.9	15.2	12.2	12.9	1.4	3.2	8.6	2.5
	51.7	11.8	12.5	18.4	30.1	2.1	9.2	13.9	10.2	12.6	2.2	3	7	1.8
	53.8	10.8	10.3	18.8	33.6	2.4	8.5	13.4	11	10	2	3.8	7.8	2.2
	43.7	10.7	11	18	21	2.8	7.2	13.9	10.4	10.3	1.6	3.3	8	2.6
	45.6	10.8	12.2	18.6	21	2	8.6	13.6	9.3	11.3	1.4	3.1	7.6	1.7
	44.6	10.1	9.4	16.8	25.5	2.7	7.5	12.8	8.8	10.8	1.7	2.4	6.5	2.1
	46.8	9.6	11.4	19.6	22.5	3.4	9.3	14.2	12	10.9	1.8	2.8	7	2
	45.1	8.8	10.2	20.2	20.3	2.7	9	15	10.6	11.5	1.5	2.4	6.8	1.7
	41.7	9.8	11	16.2	20	1.2	8	11.8	10.4	10.3	1.7	2.7	6.7	1.8
	44.8	8.9	9.2	18	20	2.6	7.5	12.9	9.9	9.9	1.3	3	6.7	2.9
	39.8	10.8	11.2	15.9	17.4	2.1	8.1	12.8	10.1	10.6	1.6	2.4	6.5	2.7
	41.5	9.4	9.6	16.5	20.2	1.3	9	12.3	10.8	9.6	1.4	2.8	6	2
	41.3	9.5	11	16.5	19.7	1.3	8.7	12.6	11.3	9.8	2	3.4	6.2	2.6
	45.7	8.2	9	18.4	23.2	2.2	9	12.5	11	10	1.2	3.3	5.8	1.6
	45	7.7	9	13.4	21.5	0.7	6.4	9.4	7.3	7.6	1.9	1.5	4.9	1.5
Amatongas Forest .. .. .	50.8	12.3	13.4	19	29.2	2.8	9	14.5	12	11.3	3	2.5	7.4	2
	50.4	11.8	12.5	19.5	25.8	1.2	11.6	14.1	13.2	11.8	1.9	3.3	7.1	2.4
	45.9	12.4	11.4	17.4	24.1	1.2	9.5	12.3	11.8	10.1	1.8	3.2	8.4	2.5
	50.6	10.3	11.1	19.3	29.2	1	10.1	13	11.9	10.6	2	3.6	7.1	1.4
	45.6	10.8	12.2	18.6	31	2	8.6	13.6	9.3	11.3	1.4	3.1	7.6	1.7

Explanation of table 1.

The figures refer to the following body measurements:

1. body length
- 2a. body breadth at middle of body
- 2b. body breadth at middle of mantle
3. length of mantle
4. distance between posterior mantle end and posterior end of body
5. length of shell slit
- 6a. distance between basal end of mantle-slit and anterior end of mantle
- 6b. distance between basal end of mantle-slit and posterior end of mantle

- 7a. distance between respiratory orifice and anterior end of mantle
- 7b. distance between respiratory orifice and posterior end of mantle
8. distance between respiratory orifice and basal border of mantle
9. length of caudal orifice
10. breadth of foot-sole in middle.
11. breadth of mid-area of foot-sole in middle.



*Colour:* The ground colour of two adult specimens from Vumba Circular Drive (Rhodesia) with body lengths of 77 and 61 mm respectively is grayish-beige to gray, with a dark gray central area on the back, becoming narrower posteriorly. This area is laterally bordered by narrow stripes of the ground colour, the latter being bordered below by blackish lateral stripes, named "Stammbinden" by Simroth. On the flanks there are dark spots. The mantle is darker gray than the ground colour, and its fine grooves are still darker. On both sides there are dark indistinct lateral stripes. The sole of the bigger specimen (length 77 mm) is unicoloured flaxen, that of the other specimen (length 61 mm) has darker pigmented lateral areas. Dark transverse parallel lineoles on the foot-fringe are typical for *Urocyclus kirkii*, also being present in juveniles. The ground colour of specimens collected in the Chiluvo and Amatongas forests (Mozambique) is brownish gray. Some specimens have a light median stripe. The sole is uniformly brownish gray, paler than the ground colour on the back. The median area of the back on most juveniles with a length of up to 30 mm is not darker than the ground colour and has distinct lateral stripes. A few juveniles are coloured as the adults are.

*Live colours* (as noted by van Bruggen): Two specimens (length 77 mm and 61 mm) from Vumba Circular Drive (Rhodesia) "black and gray", one specimen from Chiluva forest (Mozambique) "dark gray pattern".

*Body measurements:* of 89 measured specimens the body length is

- in 23 specimens less than 10 mm
- in 21 specimens 10 mm—19.9 mm
- in 17 specimens 20 mm—29.9 mm
- in 4 specimens 30 mm—39.9 mm
- in 14 specimens 40 mm—49.9 mm
- in 8 specimens 50 mm—59.9 mm
- in 1 specimen 61 mm
- in 1 specimen 77 mm

As certain measurements of preserved specimens depend on their degree of contraction, they are not arranged in order of the body length, but in that of the product body length  $\times$  body breadth.

*Shell* (fig. 22 a, b): The oblong-oval shell is embedded in a pocket at the posterior part of the mantle, opening to the exterior by the shell-slit. The nucleus is situated near the posterior margin of the shell and is often exposed through the shell-slit. Shells of two specimens have been examined, one of a specimen of 61 mm length from Vumba Circular Drive (Rhodesia), and one of a specimen of 53.6 mm length from the Chiluvo Forest (Mozambique). The first is flatter with a thinner calcarous portion than the second. The thin brownish periostracum on the surface of the shell is more developed in the first specimen and has a weak concentric and radial sculpture, the latter only distinct near the anterior border. The underside of the shell is almost smooth in the first specimen, and shows an obscure nodulation in the second.

<i>length of specimen</i>	<i>length of shell</i>	<i>breadth of shell</i>
<i>mm</i>	<i>mm</i>	<i>mm</i>
61	9	6.3
53.6	8.5	5.6

*Mandible* (fig. 23): The mandible is oxygnathous. That one of the specimen of 61 mm has a breadth of 3.5 mm.

*Radula*: The mesocone of the central teeth is smallest and enlarges on the lateral teeth towards the marginal teeth. The central and lateral teeth have delicate ectocones. The transition from lateral to marginal teeth is gradual between the 16th and 18th teeth. On one side of a row there are about 50 aculeate marginal teeth.

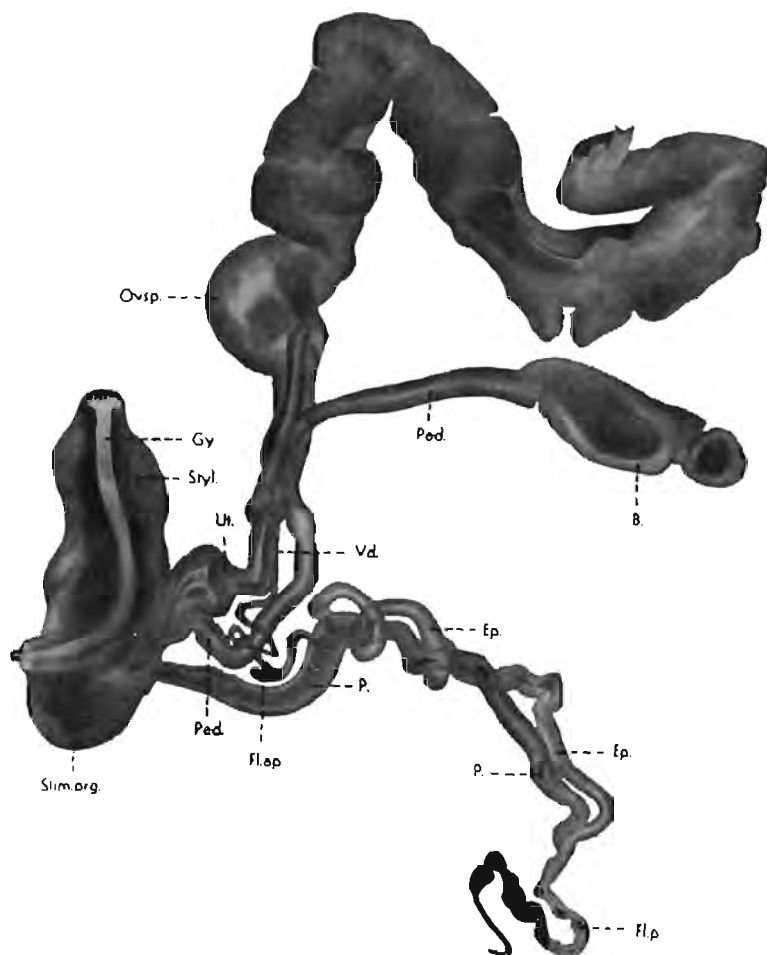


Fig. 24. *Urocyclus* (*Urocyclus*) *kirkii* Gray, from Mozambique, Chiluvo Forest. Reproductive organs. Explanation of abbreviations on p. 509.

*Reproductive System* (fig. 24): One specimen from Rhodesia, Vumba Circular Drive (body length 61 mm) and one from Mozambique, Chiluvo Forest (body length 53.6 mm) have been dissected.

The hermaphrodite gland is fusiform. The hermaphrodite duct is convolute in its proximal half. The albumen gland is relatively small. The long ovispermiduct is convolute. In the specimen from Mozambique the uterus in its distal part is incrassate, in that from Rhodesia not. The length of the pediculus of the receptaculum seminis is a little less than three times that of the oval bursa. It inosculates the uterus immediately before entering the stimulatory organ near the insertion of the penis. The vagina is very short.

The vas deferens becomes thinner short behind its branching from the oviduct. It runs along the uterus towards the stimulatory organ, where it bends towards the epiphallus. The latter ends at the insertion of the vas deferens as a small vesicular epiphallian flagellum, containing a calcareous substance. The epiphallus is twisted around the penis, which ends distally in a long penial flagellum with incrassations containing calcareous substance. The proximal half of the penis is formed by a penial sheath, containing a long penial verge, extending into the stimulatory organ.

The proximal third of the stimulatory organ contains a cavity into which the penial verge is inserted. The uterus opens into this cavity nearby. The distal two-thirds of the stimulatory organ functions as a stylophore, containing an elongate hollow gypsobelum with a weak spiral torsion. Its crenulated base inserts at the interior of the distal stylophore. The anterior end of the stylophore reaches as far as the cavity of the proximal third of the stimulatory organ, having the function of an atrium.

The reproductive system is much like that of *Urocyclus elegans* as described by Simroth (1904: 702-703, pl. 40, figs. 51-55), which differs only by its relatively longer penial flagellum and the globular bursa of the receptaculum seminis. It is evident that these species are closely related.

*Distribution and habitat:* *Urocyclus kirkii* is only known from the following localities in Rhodesia and Mozambique. Rhodesia, Vumba Circular Drive, Zonwi River bridge 760 m and Burma Valley, Nyamakari River Causeway 850 m leg. A. C. & W. H. van Bruggen 17.II.1963.—Mt. Selinda, Chirinda Forest 1100 m, leg. A. C. & W. H. van Bruggen 7.-13.II.1963. Mozambique, mouth of the River Zambezi on floating weed, type-locality (Gray 1964: 250).—Chiluvo Forest, leg. D. M. Cookson 17.XI.1963, 16.I.1964, 15.III.1964, and at 210 m, leg. A. C. & W. H. van Bruggen 19.II.1963.—Amatongas Forest, leg. D. M. Cookson 15.-16.II.1964 and at 510 m, leg. A. C. & W. H. van Bruggen 19.II.1963.

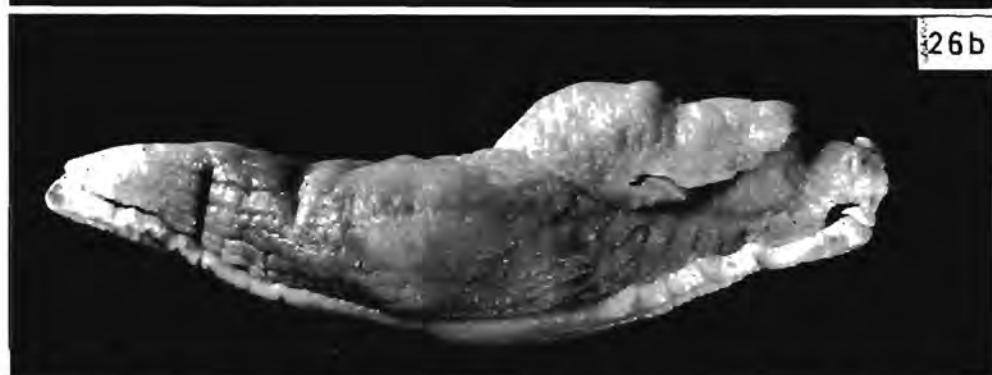
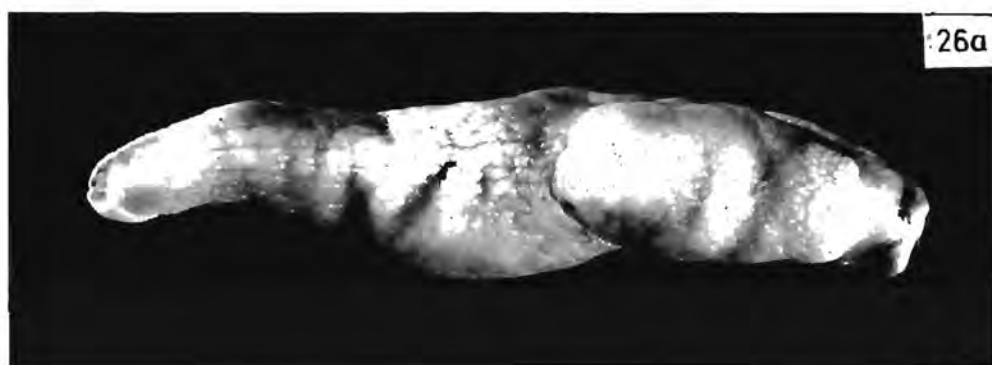
Species erroneously referred to *Urocyclus kirkii*: In Poirier (1887: 196-197, 202-226, pl. 5, figs. 1, 2, 6, pl. 6, figs. 1-2, pl. 8, fig. 1), Sturany (1899: 572 partim, without reference to original description), Germain 1935: 19-21 figs. 2-3 = *Urocyclus (Elisolimax) flavescens* (Keferstein). In Forcart (1963: 107) = *Deroceras* spec. ? juv.

#### Subgenus *Elisolimax* Cockerell, 1893

*Parmarion*.—Keferstein 1866, Malak. Bl., 13: 70-76, not *Parmarion* Fischer, 1855.

*Phosphorax* Webb & Berthelot, 1833.—Mörch 1867, J. Conch. Paris, 15: 255. *Genus inquirendum*.

*Urocyclus*.—Gibbons 1879, J. Conch. Lond. 2: 138-140 partim (for *Parmarion flavescens* Keferstein, 1866), not subgenus *Urocyclus* s.str.—Further references in the synonym of *Urocyclus (Elisolimax) flavescens*.



Figs. 25, 26. *Urocyclus (Elisolimax) flavescens* (Keferstein). (25) Specimen from Transvaal, Kruger National Park, block S 101, foot of Macili Kop. (a) dorsal view, (b) lateral view, x2.25. (26) Specimen from Natal, Pietermaritzburg. (a) dorsal view, (b) lateral view, x2.25.

*Aspidoporus*.—Martens 1879, Monatsber. Akad. Wiss. Berlin, 1879: 736, not *Aspidoporus* Fitzinger, 1833.

*Elisa* Heynemann, 1882. Nachr.-Bl. dtsh. Malak. Ges., 14 (11/12): 180. Type-species *Elisa bella* Heynemann, 1882. Homonym with *Elisa* Gray, 1855 (*Aves*).—Heynemann 1883, Jb. dtsh. Malak. Ges., 10 (1): 48.—Simroth 1883, Jb. dtsh. Malak. Ges., 10: 289-312.

*Elisolimax* Cockerell, 1893. Conchologist, 2: 187, *nom. nov.* for *Elisa* Heynemann, 1882.

The characters distinguishing the subgenera *Urocyclus* s.str. and *Elisolimax* are discussed in the description of the genus *Urocyclus*.

Martens (1860:211) first mentioned a new genus of slugs from Mozambique, without naming it. Keferstein (1866) described the specimen, to which the note of Martens referred, as *Parmarion flavescens*. Mörch (1867: 255) transferred it to the genus *Phosphorax* Webb & Berthelot, 1833—type-species *Limax nocticulus* Férussac, 1819, a *species inquirenda*—Gibbons (1879: 138) to *Urocyclus* Gray, and Martens (1879: 736) to *Aspidoporus* Fitzinger. Heynemann (1882: 180-181) published a brief description of the genus *Elisa* and its type-species *Elisa bella* from Madagascar, and referred to his detailed description (1883). Fischer (1883: 262-263) described *Urocyclus comorensis*, *vittatus* and *longicauda* from Mayotte and Mossi-Comba. He united these species with *Parmarion flavescens* Keferstein and *Urocyclus kirkii* Gray in the genus *Urocyclus*. Poirier (1887: 195-232) described the anatomy of *Urocyclus flavescens* (sub *nom. kirkii*), *comorensis*, *vittatus*, *longicauda*, *acuminatus* and

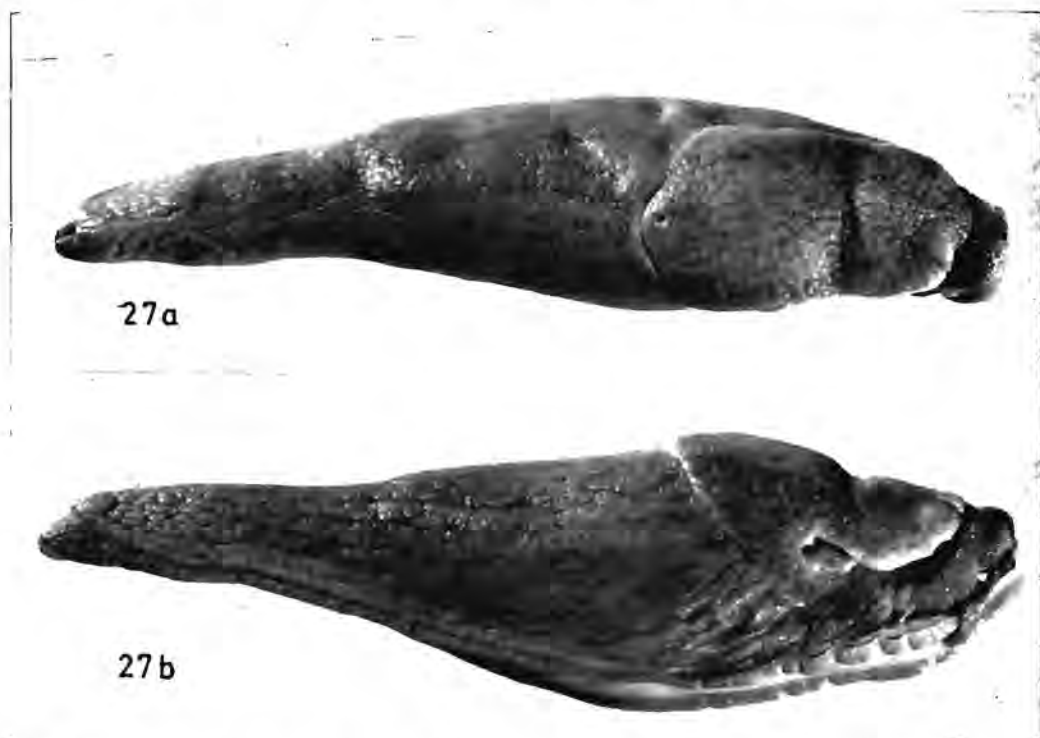


Fig. 27. *Urocyclus* (*Elisolimax*) *flavescens* (Keferstein), from Natal, mouth of Tugela River. (a) dorsal view, (b) lateral view, x2.25.

*madagascariensis* in detail. He came (p. 224) to the same conclusion as Fischer (1883), viz., that their anatomical characters, especially those of the reproductive organs, prove that they all belong to one systematic unit. Later authors have accepted this without realising that Poirier did not describe the authentic *Urocyclus* (*Urocyclus*) *kirkii* but *Urocyclus* (*Elisolimax*) *flavescens*.

*Distribution:* The distribution of the subgenus *Elisolimax* extends from Kenya in East Africa to Natal. Further records are known from the Comoro Islands and Madagascar.

*Urocyclus* (*Elisolimax*) *flavescens* (Keferstein). Figs. 25-31

*Parmarion flavescens* Keferstein, 1866. Malak. Bl., 13: 70, pl. 2 figs. 1-8. Holotype in Zool. Mus. Berlin. Type-locality: Mozambique, Inhambane.

*Phosphorax flavescens* (Keferstein).—Mörch, 1867 J. Conch. Paris, 15: 255.

*Urocyclus flavescens* (Keferstein).—Gibbons 1879, J. Conch. Lond. 2: 138.—Fischer 1883, J. Conch. Paris, 30: 269.—Heynemann 1884, Jb. dtsh. Malak. Ges., 11: 5-7 (redescription), pl. 1 figs. 2, 3.—Germain 1918, Bull. Mus. Hist. nat. Paris, 24: 358-359.—Connolly 1912, Ann. S. Afr. Mus., 11: 123 and 1939, *op. cit.* 33: 166-167.—Forcart 1963, Proc. Malac. Soc. Lond. 35 (2/3): 107.

*Urocyclus flavescens* var. *pallidus* Gibbons, 1879, J. Conch. Lond., 2: 139. Type-locality: Mozambique. *Aspidoporus flavescens* (Keferstein).—Martens 1879, Monatsber. Akad. Wiss. Berlin, 1879: 736.

*Aspidoporus fasciatus* Martens, 1879. *Op. cit.*: 736. Holotype in Zool. Mus. Berlin. Type-locality: Mozambique, Rio Quelimane.

*Urocyclus kirkii*.—? Binney 1879, Bull. Mus. comp. Zool., 5: 333-334, 356, pl. 2 figs. D not C mandible, E not D radula.—? Binney 1885, Ann. New York Acad. Sci. 3: 84, 136, pl. 16 fig. K mandible, pl. 17 fig. N Radula.—Poirier 1887, Bull. Soc. France, 196-197, pl. 5 figs. 1-2 habitus, pl. 8 fig. 1 radula.—Sturany 1899, Denkschr. Akad. Wiss. Wien, 76: 572 partim.—Germain 1918, Bull. Mus. Hist. nat. Paris, 24: 361-362.—Germain 1935, Mem. Estud. Mus. Zool. Coimbra, (1) 80: 19-21.

*Urocyclus fasciatus* (Martens).—Fischer 1883, J. Conch. Paris, 30: 269.—Heynemann 1884, Jb. dtsh. Malak. Ges. 11: 8, 16, pl. 1 figs. 4 a-c, 5a?—Germain 1918, Bull. Mus. Hist. nat. Paris, 24: 360-361. Connolly 1912, Ann. S. Afr. Mus., 11: 123.—Connolly 1939, *op. cit.*, 33: 167.—Forcart 1963, Proc. Malac. Soc. Lond. 35 (2/3): 107.

*Urocyclus pallescens* Cockerell, 1891. Ann. Mag. Nat. Hist., (6) 7: 101. Holotype Brit. Mus. London. Type-locality: Natal, Port Natal = Durban.—Connolly 1912, Ann. S. Afr. Mus., 11: 124.—Connolly 1939 *op. cit.*, 33: 167-168.—Forcart 1963, Proc. Malac. Soc. Lond., 35 (2/3): 107.

The considerable variation of *Urocyclus flavescens* in shape and colour caused the multiple naming of this species (figs. 25-28).

*Habitus illustrations* (figs. 25-28): Keferstein 1866: pl. 2, figs. 2-3 holotypus.—Heynemann 1884: pl. 1, figs. 4 a-c *sub nom.* *Urocyclus fasciatus*.—Poirier 1887: pl. 5, figs. 1-2 *sub nom.* *Urocyclus kirkii*.

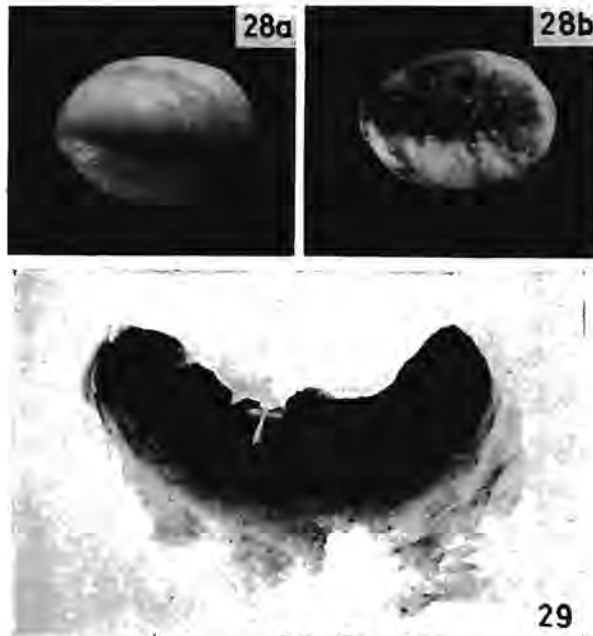
*External Characters* (figs. 25, 26, 27): A slender slug, adult with a body-length of about 30 mm. Posterior part of body more slender than anterior part, tapering towards the tail. Back not keeled, with fine longitudinal grooves connected by short transverse grooves. At the distal end a big orifice of the caudal gland. Mantle shagreened. The middle part of its posterior end is vaulted and situated in a conform deepening of the back. In most specimens is the shell-slit so small that the shell is invisible. The foot-sole is tripartite, its central area a little narrower than the lateral areas.

*Colour:* The ground-colour may be pale yellow, yellowish-brown or gray. The dorsum is unicoloured or it has two, usually weak, light lateral stripes. Rarely also a light median stripe is present.

Specimens of 26 lots have been examined. Those of 24 lots show no variability, and only two contain specimens of different colour types. The specimens of eight lots are uniform yellow or yellowish-brown, those of one lot are uniform gray. In 15 lots the back

is unicoloured, in ten lots it has light lateral stripes, and in four lots a light median stripe. One lot contains one specimen with unicoloured back and one having lateral and median stripes. In one lot the only specimen has solely a median stripe.

In 14 lots the mantle has lateral stripes. In two lots are specimens with striped and with a unicoloured mantle. In 21 lots the central area of the mantle is of the ground colour, and in four lots it is darker. In one lot these colour phases of the mantle are mixed.



Figs. 28, 29. *Urocyclus (Elisolimax) flavescens* (Keferstein). (28) Specimen from Natal, Pietermaritzburg. (a) dorsal view, (b) ventral view, of shell, x4.5. (29) Specimen from Rhodesia, Mt Selinda, Chirinda Forest. Mandible x15.

The fringe of the foot-sole is always without dark transverse parallel lineoles.

The colour-variants are mostly coherent in populations, but show no geographical variability.

*Live colours* (as noted by van Bruggen): Yellowish-gray, one specimen from Mkuzi Game Reserve (Zululand), one from the mouth of the Tugela River, and one from Pietermaritzburg.

Bright lemon-yellow, six from Mt. Selinda, Chirinda Forest 1100 m (Rhodesia).

Yellow, one from Vumba Circular Drive (Rhodesia) and four from Pietermaritzburg.

One yellowish-white, and 13 yellowish-white with brownish gray foot-sole from Ndumu Game Reserve (Zululand).

*Body measurements of 40 specimens:*

	<i>minimal</i>	<i>maximal</i>	<i>average</i>
Body length . . . . .	18.5 mm	58 mm	37.3 mm
Mantle length . . . . .	7.7 mm	21.8 mm	14.5 mm
Mantle length in % of body length	32%	49%	39%
Length of shell-slit . . . . .	0.4 mm	1.8 mm	0.9 mm
Length of shell-slit in % of mantle length . . . . .	3%	12%	6%
Distance between mantle-slit and anterior end of mantle . . . . .	3.6 mm	10 mm	6.6 mm

*Shell* (fig. 28 a, b): Illustration in Keferstein 1866: pl. 2, fig. 4 (bad). The shell of a specimen with a length of 47 mm from Pietermaritzburg has been examined. The contour of the vaulted shell is oval. The nucleus is on the posterior end. The upper surface has a fine concentric sculpture, and is covered with a thin periostracum of a horny tinge. The lower side shows an obscure nodulation. Length 6.2 mm, breadth 5.6 mm.

*Mandible* (fig. 29): Illustrations in Keferstein 1866: pl. 2, fig. 6, copies in Heynemann 1884: pl. 1, fig. 2 b;? Binney 1879: pl. 2, fig. D, copied in Heynemann 1884 pl. 1, fig. 5, and in Binney 1885: pl. 16, fig. K; Poirier 1887: pl. 1, fig. 6.

The mandible is oxygnathous, more or less arcuate, being weakly vertically carinate in the centre, the keel terminating in a median projection on the cutting margin. The figures of

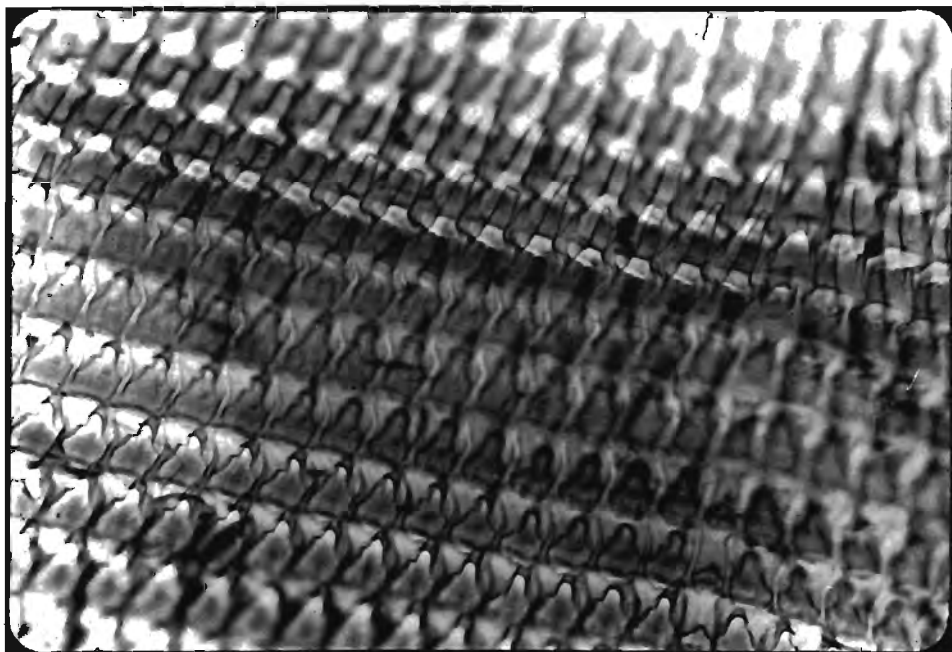


Fig. 30. *Urocyclus (Elisolimax) flavescens* (Keferstein), from Rhodesia, South Inyanga. Median teeth of abnormal radula.



Keferstein (1866: pl. 2, fig. 6) and Poirier (1887: pl. 1, fig. 6) are correct, that of Binney (1879: pl. 2, fig. D), illustrating a leiognathous mandible not. Whether this illustration figures an aberrant mandible, that of another species, or is simply a poor drawing, cannot be ascertained.

*Radula* (fig. 30): Descriptions: Keferstein 1866: 71, pl. 2, fig. 8, copied in Heynemann 1884: pl. 1, fig. 2a; Binney 1879: 334, pl. 2, fig. E (not D), copied in Binney 1885: pl. 17, fig. N; Poirier 1887: 204, pl. 8, fig. 1.

The radulae of two specimens from Rhodesia, Mount Selinda and South Inyanga, have been examined. The teeth vary considerably within the same radula.

The central teeth are smaller than the lateral teeth. They are more or less distinctly tricuspid. Most lateral teeth have a mesocone with a small secondary internal cusp, and a well developed ectocone. They change gradually between the 17th and 20th teeth to marginal teeth with aculeate cusps, partly with a secondary cusp.

The lateral teeth of the radula of the specimen from South Inyanga vary in different rows. In some they are as described above, in others they are shaped as marginal teeth (fig. 30). If these differences had been found in different individuals, they would probably have been considered specific characters.

*Anatomy*: Keferstein 1866: 71-72, general dissection pl. 2, fig. 5; nervous system pl. 2, fig. 7. Poirier 1887: 202-204 *sub nom. Urocyclus kirkii*, general dissection pl. 6, fig. 1; digestive system pl. 6, fig. 2. Germain 1935: 20-21 *sub nom. Urocyclus kirkii*, reproductive system fig. 4.

*Reproductive System* (fig. 31): One specimen from Mozambique, two from Rhodesia, two from Transvaal, one from Zululand, and three from Natal have been dissected.

The pediculus of the receptaculum seminis is a little longer than double the length of the bursa. The vagina inosculates the stimulatory organ at its proximal half, close to the insertion of the penis.

The epiphallus ends distally, at the insertion of the vas deferens, in a small vesicular epiphallian flagellum containing calcareous substance. The penis ends at the insertion of the epiphallus in a relative short penial flagellum. The proximal portion of the penis forms a penial sheath, containing a penial verge and inosculating the stimulatory organ.

The stimulatory organ contains no gypsobelum. It ends distally in a short muscular portion, where the apical and lateral retractor muscles are inserted, connected to the body wall near the buccal mass. The erected stimulatory organ was studied in specimens found in copula on Mount Selinda (Rhodesia). The protruding stimulatory organ is tongue-shaped with swollen margins. At its proximal end, near the genital orifice in the body wall, the hemispheroid tip of the verge is protruded. The female opening is situated at the base of the protruded stimulatory organ.

*Distribution*: The distribution of *Urocyclus flavescens* reaches from the Rio Quelimane in Mozambique and the eastern frontier region of Rhodesia, to Natal.

*Hypsometrical distribution*: From sea-level to 1400 m.

*Localities*: Rhodesia: Umvukwes, leg. A. J. Cookson XII, 1963.—South Inyanga, forest near Pungwe bridge, leg. A. C. van Bruggen I.II.1959.—Vumba Circular Drive, Burma Valley, Nyamakari River Causeway, 850 m, leg. A. C. & W. H. van Bruggen 17.II.1963.—Mt. Vumba 1400 m (Germain 1918: 358-360).—Mt. Selinda, Chirinda Forest, 1150-1200 m, leg. A. C. van Bruggen 15.-26.I.1959 & 7.-13.II.1963. Mozambique: Rio Quelimane (type-locality of *Aspidoporus fasciatus* Martens, 1879).—Itumbe Forest on the upper

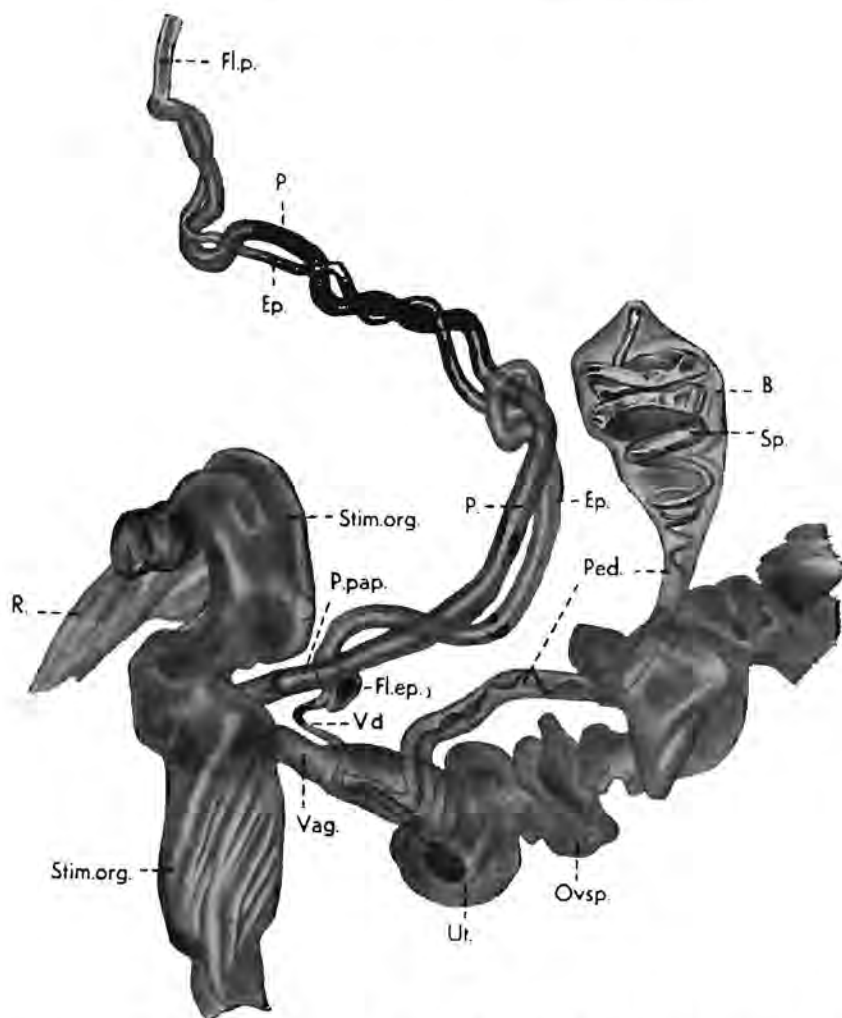


Fig. 31. *Urocyclus (Elisolimax) flavescens* (Keferstein), from Rhodesia, South Inyanga. Reproductive organs. Explanation of abbreviations on p. 509.

course of the Sanadzé River (Germain 1935: 19-21 = *Urocyclus kirkii*).—Chiluvo Forest, leg. D. M. Cookson 15.-16.III.1964.—Andrada (Germain 1918: 360-362 = *Urocyclus fasciatus* and *kirkii*).—Environs of Vila Pery, path of Chizombero (Germain 1935: 17-18).—? Kondoa (= Gondola?) (Poirier 1887: 196-197 = *Urocyclus kirkii*).—Inhambane (type-locality of *Parmarion flavescens* Keferstein, 1866).—Delagoa Bay (Sturany 1899: 572 = *Urocyclus kirkii*. Connolly 1912: 123); Inhaca Island, Cabo Inhaca, leg. D. G. Broadley IV.1962. Transvaal: Kruger National Park block S 7, Skukuza, leg. Biologist 27.I.1961 (KNP); block S 33, Lower Sabie, south shore of Sabie River, leg. A. C. van Bruggen 20.II.1964; block S 101 foot of Macili Kop, leg. Biologist 16.I.1962 (KNP).—Barberton (Forcart 1963: 103, 107 = *Urocyclus fasciatus*). Zululand: Northern Zululand, leg. H. H. Curson.—Ndumu Game Reserve rest camp area; around Nyamiti Pan; Fig Tree forest on confluence of Usutu and Pongola Rivers; Pongola River forest near pumphouse, leg. A. C. & W. H. van Bruggen 11.-14.I.1964.—Gwalaweni Forest (Forcart 1963: 103, 107 = *Urocyclus fasciatus*).—Mkuzi Game Reserve near warden's house, leg. A. C. & W. H. van Bruggen 4.I.1964.—St. Lucia Bay (Forcart 1963: 103).—St. Lucia Game Reserve, Charters Greek rest camp, leg. A. C. & W. H. van Bruggen

24.-26.IV.1963.—Hluhluwe Game Reserve (Forcart 1963: 103, 107 = *Urocyclus fasciatus* and *pallescens*); rest camp, leg. A. C. van Bruggen IV.1960.—Kosi Bay (Forcart 1963: 103, 107). Natal: Mouth of Tugela River, south bank in dune forest, leg. A. C. & W. H. van Bruggen 31.I.1964.—Stanger, from outside the village, on water tank, leg. D. H. M. Brooks 13.XII.1963.—Pietermaritzburg, leg. E. Warren 29.I.1912 and Mrs. W. H. van Bruggen 24.-26.IV.1963 & 3.IV.1965, Connolly (1912: 123 = *Urocyclus fasciatus* and *flavescens*); Alexandra Road, leg. A. C. & W. H. van Bruggen 11.I.1965.—Pinetown (Connolly 1912: 123).—Durban (type-locality of *Urocyclus pallescens* Cockerell, 1891. Sturany 1899 = *Urocyclus kirkii*); Stella Bush, leg. F. Toppin II.1905; Burman Bush, leg. O. Bourquin 17.—21.XI.1962.—North Coast, Compensation Beach.

**Biology:** Van Bruggen adds the following notes on the habitat of specimens from Mt. Selinda, Chirinda Forest (Rhodesia), 1150 m alt.:

“Common mainly in sunny spots on the edge of the forest or in grass; also seen in forest proper. Mating seen a few times, no eggs or juveniles found; mating already in progress at sunrise.”

Other specimens have been found in a dune forest, under a log, at the mouth of the Tugela River (Natal), on cauliflower in Pietermaritzburg, and on sea-weed at Inhaca Island (Delagoa Bay).

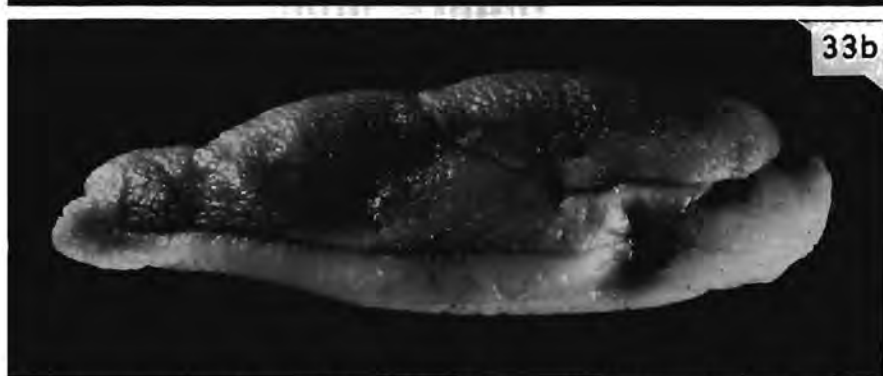
#### Genus “*Kirkia* Pollonera, 1909”

Pollonera (1909: 192-193) described a genus *Kirkia* upon a supposition; he assumed from Heynemann (1884: 11), that the species Gibbons (1879: 138-139) mentioned as *Urocyclus flavescens* (Keferstein) is specifically different from this species and *Urocyclus kirkii* Gray. He named it *Kirkia flavescens* Gibbons, against all rules of zoological nomenclature. He based it exclusively on bibliographic references, mainly the radula figured by Binney (1879: pl. 2, fig. C) and reproduced by Heynemann (1884: pl. 1, fig. 5b), furthermore on the description Gibbons (1879: 138-139) gave of living specimens of *Urocyclus flavescens*, the ones which Binney (1879: 333-334) named *Urocyclus kirkii*. In the text Binney referred by error to the figure of the mandible on his pl. 2, fig. C, which represents the radula of *Triodopsis vultuosa* (Gould) of the family Polygyridae, and to that of the radula on pl. 2, fig. D, which represents the mandible of the species he named *Urocyclus kirkii*; but in the “Explanation of the Plates” (p. 356) he referred correctly to pl. 2, fig. D for the mandible, and to fig. E for the radula. Heynemann (1884: 11, pl. 1, figs. 5 a, b) perpetuated these misunderstandings by referring to Binney (1879: pl. 2, fig. B) for the figure of the mandible, which represents the radula of *Apera gibbonsi*, and for that of the radula to pl. 2, fig. D, which represents the mandible. He reproduced on pl. 1, fig. 5a the mandible Binney figured on pl. 2, fig. D, and on pl. 1, fig. 5B Binney’s pl. 2, fig. C, which represents the radula of *Triodopsis vultuosa*.

The generic name “*Kirkia* Pollonera” and the specific name “*Kirkia flavescens* Gibbons”, being based partly on figures of the radula of *Triodopsis vultuosa*, and partly on the description Gibbons gave of *Urocyclus flavescens* are hypothetical concepts. They must be excluded from zoological nomenclature (cf. *Intern. Code Zool. Nomencl.*: Art 1).

#### Genus *Atoxon* Simroth, 1889

*Atoxon* Simroth, 1889. N. Act. Acad. Leop., 54: 58. Type-species: *Atoxon hildebrandti* Simroth, 1889. Type-designation: Pilsbry 1919, Bull. Amer. Mus. nat. Hist., 40: 287.



Figs. 32, 33. *Atoxon meridionalis* n. sp., from Zululand, Eshowe. (32) Holotype (dissected). (a) dorsal view (b) lateral view, x3. (33) Paratype. (a) dorsal view (b) lateral view, x3.

Verdcourt (1960: 203-209), revising the genus *Atoxon* wrote: "The species in this genus are most ill-defined and series of strict topotypes are needed for comparative dissections. Many of Simroth's species were poorly described from quite inadequate material, often immature specimens; moreover the type localities are often not defined."

For the determination of species known up to 1960, the student is referred to Verdcourt's key (1960: 203-204). Three new species have now been discovered in material from Mozambique, Rhodesia, and Zululand:

1. Receptaculum seminis with elongate bursa, with pediculus shorter than bursa (figs. 35, 37) . . . . . 2
- Receptaculum seminis with globular bursa, with pediculus much longer than bursa (fig. 40) . . . . . *Atoxon cooksoni* n.sp.
2. (1.) Uterus and pediculus of the receptaculum seminis unite at their inosculation into a big, triangular atrium. No vagina (fig. 37) . . . . . *Atoxon bruggeni* n.sp.
- Uterus and pediculus unite into a vagina, which inosculates into an elongate atrium (fig. 35) . . . . . *Atoxon meridionalis* n.sp.

Further, a juvenile *Atoxon* from Malawi has been examined; this has some resemblance to the unnamed juvenile specimen Verdcourt (1962: 30-31, figs. 5, 6) described from Mt. Gorongosa in Mozambique.

*Distribution:* The area between 4° N and 4° S and between 28° and 38° E in the Central African Highlands is the distribution centre of the genus *Atoxon*, from where 13 forms are known, 11 being named. *Atoxon* is known south of this area from Tanzania in the Western Province (Verdcourt 1962: 30 = *Atoxon* spec. ?) and the Southern Highlands (type-locality of *Atoxon fuelleborni* Simroth 1910), from Malawi, Mozambique, Rhodesia, and Zululand.

Isolated habitats are known from northern Somalia (type-locality of *Atoxon hildebrandti* Simroth 1889), and from the province Léopoldville in Congo (type-locality of *Atoxon schulzei* Simroth, 1889). Further research on African slugs may yet fill up the gaps in the distribution.

*Hypsometrical distribution:* *Atoxon* lives in altitudes from sea level to 1500 m.

#### ***Atoxon meridionalis* n.sp. Figs. 32-34, 36**

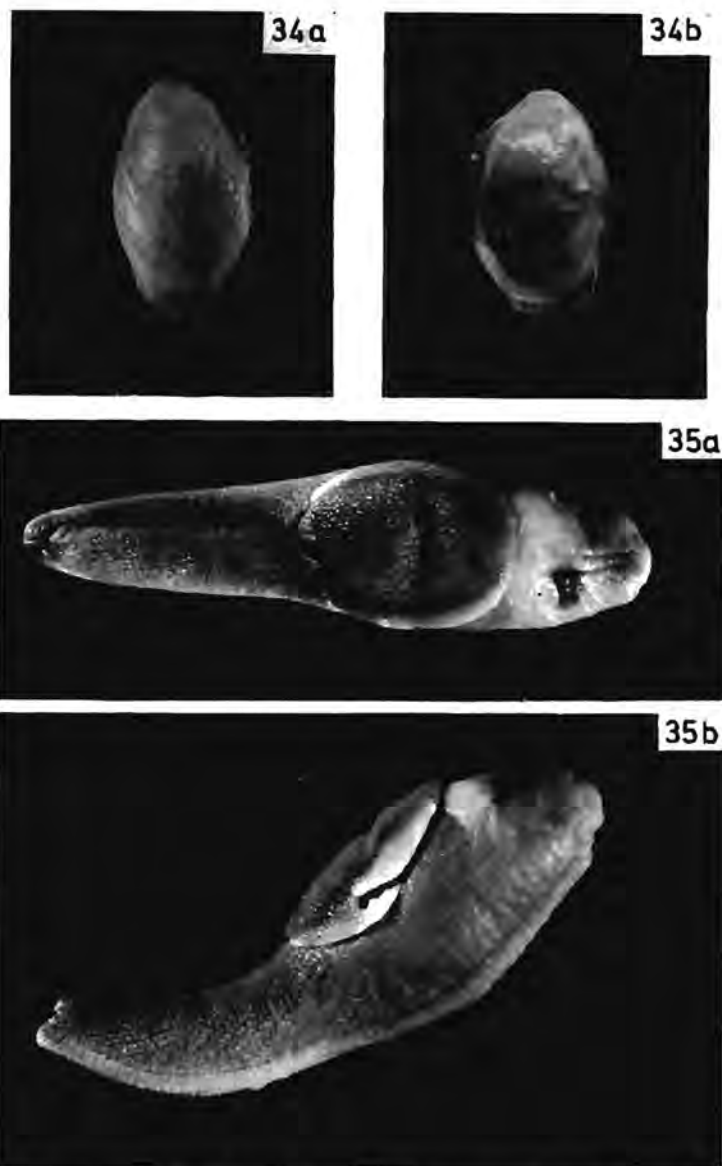
*Urocyclus flavescens*.—Forcart 1963, Proc. Malac. Soc. Lond., 35 (2/3): 107 *partim*

Holotype in Natal Museum, Pietermaritzburg.

*Type-locality:* Zululand, Eshowe.

*Paratypes:* Seven from Rhodesia (Vumba Laurenceville). Nineteen from Zululand (five from Hluhluwe Game Reserve, two from St. Lucia Game Reserve, and twelve from Eshowe).

*Diagnosis:* An *Atoxon* with affinities to *Atoxon lineatum* Simroth. It differs from that species by its stouter body, the weakly developed or absent keel, the indistinct or absent lateral stripes, and the relatively shorter penial sheath, provided with a stout penial verge over its entire length.



Figs. 34, 35. (34) *Atoxon meridionalis* n. sp., holotype from Zululand, Eshowe. (a) dorsal view, (b) ventral view, of shell,  $\times 7.5$ . (35) *Atoxon bruggeni* n. sp., holotype from Rhodesia, Vumba Mountains, Laurenceville. (a) dorsal view, (b) lateral view,  $\times 3.75$ .

*External Characters* (figs. 32-33): A stout slug, becoming mature at a length of  $\pm 30$  mm. Body with fine grooves running from the mantle to the peripodial groove, being connected by finer transversal grooves. The mantle is weakly shagreened. The respiratory orifice is situated behind the middle of the mantle. The shell-pore is small.

Body and mantle are grayish-yellow. The mantle is unicoloured or with lateral stripes. The specimens from Vumba and the St. Lucia Game Reserve have a light median strip on the back.

*Live colour:* Van Bruggen noted of a specimen from the St. Lucia Game Reserve: "body mainly gray".

*Body measurements:*

- (a) Measurements of the holotype: body length 34 mm; breadth at middle of body 9 mm; length of mantle 15.5 mm; distance between respiratory orifice and anterior end of mantle 10.4 mm; distance between respiratory orifice and posterior end of mantle 7.4 mm; breadth of sole in middle 6.7 mm; breadth of mid-area of sole in middle 1.7 mm.

- (b) Measurements of paratypes:

	<i>body-length</i>	<i>breadth at middle of body</i>	<i>mantle-length</i>
	<i>mm</i>	<i>mm</i>	<i>mm</i>
Rhodesia, Vumba . . . . .	21.5	5.5	10.8
	27.7	5.6	12.2
Zululand:			
Hluhluwe Game Reserve . .	34	8.5	13.7
St. Lucia Game Reserve . .	28.3	7	13
Eshowe . . . . .	29.4	6.5	14
	32.3	8	16.4
	35	7.3	16.5
	35.2	9.3	17
	35.5	6.3	16.7

*Shell* (fig. 34 a, b): The shell of a specimen from Eshowe (body-length 29.4 mm) is elongate oval. Length 3.9 mm; breadth 2.5 mm; diameter of nucleus 0.9 mm.

*Reproductive system* (fig. 36): The hermaphrodite gland is embedded in the anterior part of the posterior division of the liver. The remaining organs are much like those of *Atoxon lineatum*, as described and figured by Simroth (1912: 35-36, pl. 3, fig. 2 A, B). They differ in the longer penial flagellum and the relative shorter penial sheath. The penial verge ends in a short pointed glans. The uterus and the pediculus of the receptaculum seminis inosculate a short vagina.

*Distribution and habitat:* Rhodesia, Vumba, Laurenceville, in forest, 1200 m, leg. A. C. & W. H. van Bruggen 15.-16.II.1963, and D. M. Cookson XII.1963.

Zululand: Hluhluwe Game Reserve (Forcart 1963: 107 = *Urocyclus flavescens*). St. Lucia Game Reserve, Charters Creek, under log, leg. A. C. van Bruggen 28.XI.-3.XII.1962, and indigenous bush near Charters Creek, leg. A. C. & W. H. van Bruggen 18.V.1965. Eshowe, leg. F. Toppin V.1905 and ? I.1923.

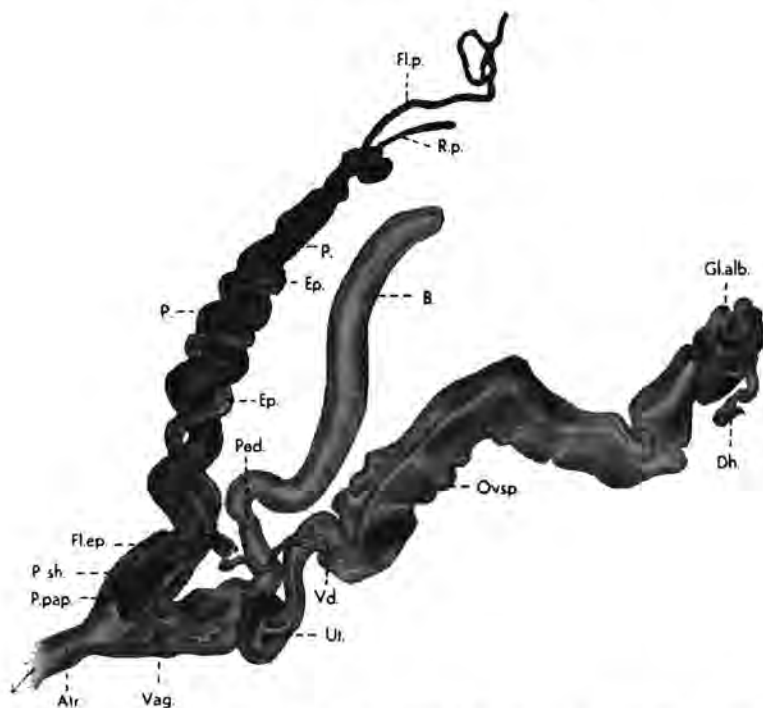


Fig. 36. *Atoxon meridionalis* n. sp., holotype from Zululand, Eshowe. Reproductive organs. Explanation of abbreviations on p. 509.

***Atoxon bruggeni* n.sp. Figs. 35, 37**

Holotype in Natal Museum, Pietermaritzburg.

*Type-locality*: Rhodesia, Vumba, Laurenceville.

Three paratypes from the type-locality.

*Etymology*: *Atoxon bruggeni* n.sp. is dedicated to Dr. A. C. van Bruggen.

*Diagnosis*: A small *Atoxon*, becoming mature at a length of  $\pm 19$  mm. The uterus and pedunculus of the receptaculum seminis insert separately in the atrium. The receptaculum seminis consists of an elongate bursa and a shorter pediculus.

*External Characters* (fig. 35 a, b): The back ends in a well developed caudal horn. A dorsal keel from the mantle to the caudal horn gradually becomes more pronounced toward the end. Body grooves are well developed on the head and on the body behind the mantle. The mantle is shagreened. The respiratory orifice of the holotype is behind and that of the paratypes near the middle of the mantle. The shell-opening is small. The back is olive brown, the basal and anterior parts of the body are grayish yellow. The mantle has distinct blackish lateral stripes, between these stripes the colour is olive brown, and below them golden brown.



*Body measurements:*

	<i>Holotype</i>		<i>Paratypes</i>	
	<i>mm</i>	<i>mm</i>	<i>mm</i>	<i>dissected specimen</i> <i>mm</i>
Body length .. .. .	23	21.5	18	19.3
Body breadth in middle .. ..	6	6	4.6	4.8
Length of mantle .. .. .	8	9.3	8.1	7.7
Length of back .. .. .	10.7	9.7	9.5	8
Length of shell-slit .. .. .	0.4	1.1	1.2	0.7
Distance between respiratory orifice and anterior end of mantle	5.6	5.8	4.2	
Distance between respiratory orifice and posterior end of mantle	4.3	5.8	4	
Length of sole .. .. .	21.8	20.5	17.5	19.2
Breadth of sole in middle .. ..	3.8	3.9	3.6	3.3
Breadth of mid-area of sole in middle .. .. .	1.1	1.1	1	0.9

*Reproductive System* (fig. 37): The penial flagellum is relatively short. The penis ends in a voluminous penial sheath, containing a penial verge with a long pointed glans. The uterus and pediculus of the receptaculum seminis insert separately in the atrium. The receptaculum seminis consists of a large elongated bursa, in the dissected specimen containing a spermatophore, and of a much shorter pediculus.

*Distribution:* Rhodesia, Vumba, Laurenceville, leg. D. M. & A. J. Cookson XII.1963.

***Atoxon cooksoni* n.sp. Figs. 38-40**

Holotype in Natal Museum, Pietermaritzburg.

*Type-locality:* Mozambique, Chiluvo Forest. Three paratypes from the type-locality.

*Etymology:* *Atoxon cooksoni* is dedicated to its collector, the late David M. Cookson, M.C., outstanding naturalist of Umtali, Rhodesia.

*Diagnosis:* An *Atoxon* with affinities to *Atoxon carli* Simroth, from which it differs in the elongate penial verge, and the absence of an atrium.

*External Characters* (figs. 38 a, b): Hind end of body pointed. Slug adult at a length of  $\pm 39$  mm. The back ends posteriorly in a rounded lobe, anterior to the posterior end of the foot. The slit of the caudal gland begins under this lobe and runs to the posterior end of the foot. The anterior part of the back has a feeble dorsal keel, and a light dorsal stripe runs from the mantle to the posterior lobe. The mantle is shagreened or finely polygonally reticulate. The ground colour is grayish yellow, on the mantle and on the back covered by grayish brown to blackish pigment. On the back there are two lateral stripes and a more or less distinct dorsal stripe of ground colour.

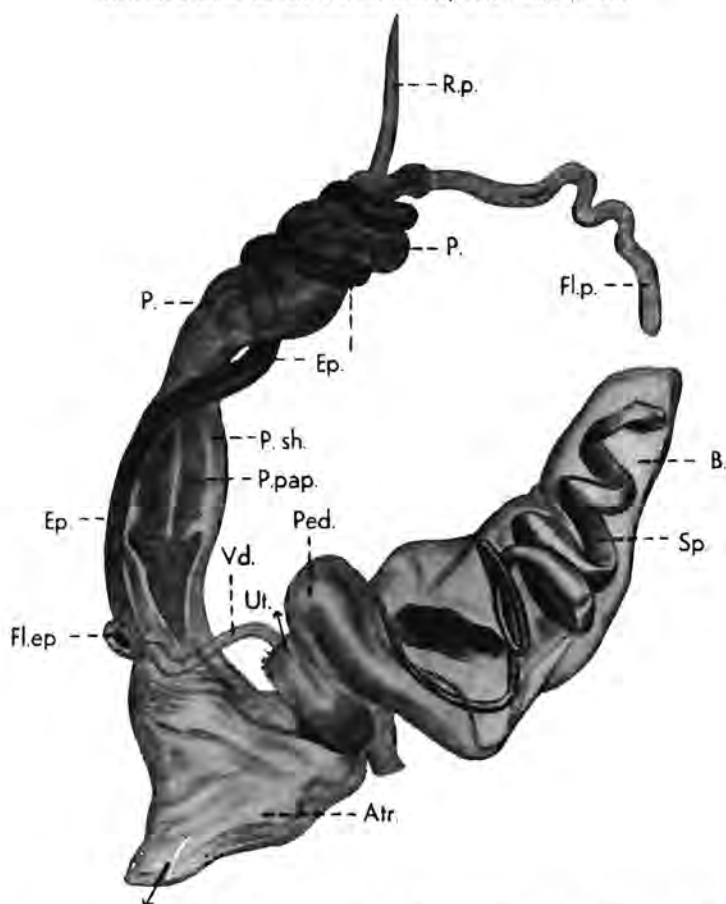


Fig. 37. *Atoxon bruggeni* n. sp., paratype from Rhodesia, Vumba Mountains, Laurenceville. Reproductive organs. Explanation of abbreviations on p. 509.

Body measurements:	Holotype	dissected specimen	Paratypes	
	mm	mm	mm	mm
Body length .. .. .	46	39.4	39.8	40
Body breadth at middle .. ..	10	8	8.7	8
Mantle length .. .. .	11	7.3	10.2	9.8
Length of back .. .. .	26.5	24.3	18.1	21.7
Length of shell slit .. .. .	1	0.9	0.7	0.7
Distance between respiratory orifice and anterior end of mantle ..	11.4	8	9.7	9
Distance between respiratory orifice and hind end of mantle ..	11.2	9	10.3	8.4
Length of sole .. .. .	45	40	38	37.2
Breadth of sole in middle .. ..	4.2	4.5	4.7	3.7
Breadth of mid-area of sole in middle .. .. .	1.1	1.5	1.3	1.1



Figs. 38, 39. *Atoxox cooksoni* n. sp., from Mozambique, Chiluvo Forest. (38) Holotype. (a) dorsal view, (b) lateral view, x2.25. (39) Paratype. (a) dorsal view, (b) ventral view, of shell, x7.5.

*Shell* (fig. 39 a, b): The shell of the dissected specimen has some resemblance to that of *Ancylus fluviatilis* Müller. The nucleus is slightly asymmetrically situated on the right side, reaching a little beyond the posterior shell margin. A thin pale yellow periostracum covers

the upper surface. The lower surface is irregularly crystallized, white and without periostracum. Shell length 7 mm, breadth 5 mm, nucleus length 3.5 mm, breadth 2.3 mm.

*Reproductive system* (fig. 40): The hermaphrodite gland is embedded in the anterior lobe of the liver. The hermaphrodite duct is only convolute before the insertion of the vesicula seminalis. Uterus and pediculus of the receptaculum seminis unite at the genital orifice, where the penis is also inserted without uniting with the female ducts to form an

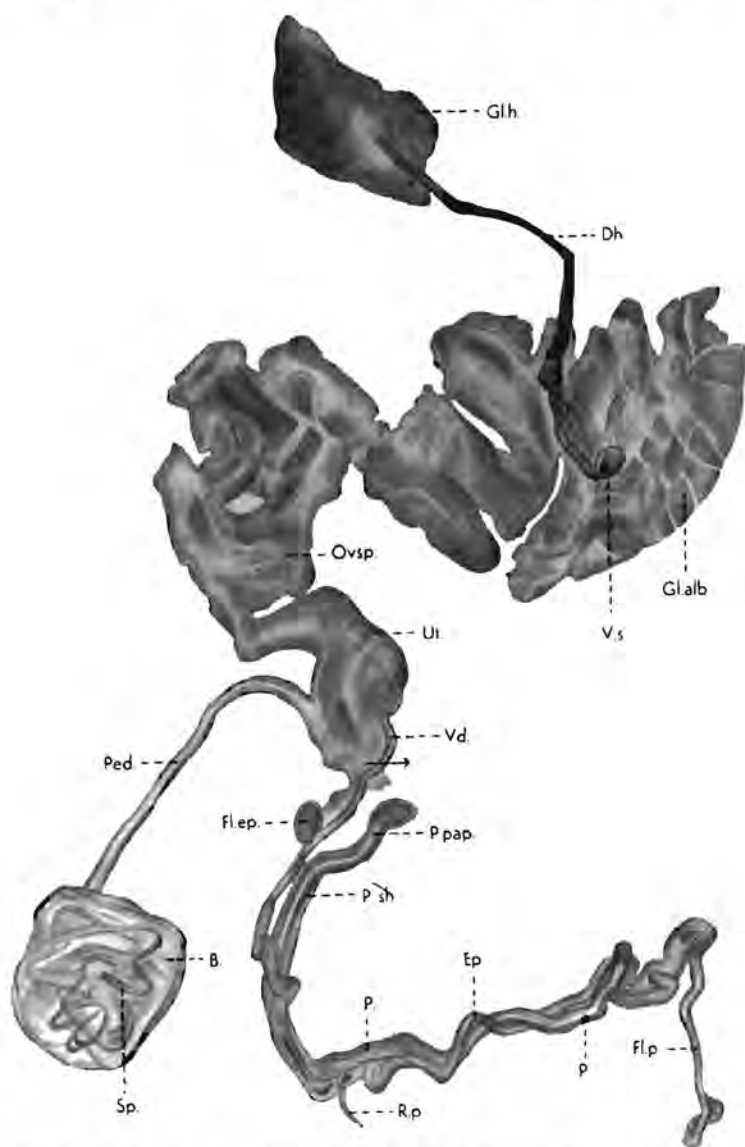


Fig. 40. *Atoxon cooksoni* n. sp., paratype from Mozambique, Chiluvo Forest. Reproductive organs. Explanation of abbreviations on p. 509.

atrium. The proximal portion of the uterus is swollen, containing a muscular uterine papilla. The receptaculum seminis is composed of a spherical bursa (containing remnants of a spermatophore in the examined specimen) and of a pediculus, being twice as long as the diameter of the bursa. The vas deferens is short. The epiphallus ends at the insertion of the vas deferens as a vesicular flagellum, containing calcareous substance, and is twisted around the penis, which ends posteriorly as an elongate penial flagellum. The penial sheath contains a long penial verge terminating in an oval glans. The reproductive organs of *Atoxon cooksoni* have been compared with those of syntypes of *Atoxon carli* Simroth from the Museum of Natural History in Geneva. It has been ascertained that Simroth's description and figure (1912: 33-34, pl. 3, fig. 1A) are not correct. The uterus and pediculus of the receptaculum seminis do not unite to form a vagina, attached to the body-wall with fine muscles, as mentioned by Simroth, but insert separately in the atrium, which is attached to the body-wall with fine muscles. A vagina is absent.

*Distribution:* Mozambique, Chiluvo Forest, leg. D. M. Cookson 16.I.1964.

*Atoxon spec.* Verdcourt, 1962

*Atoxon spec.* Verdcourt, 1962. J. East. Afr. nat. Hist. Soc., 24 (1): 30-31, figs. 5, 6.

Verdcourt (1962) described but did not name an *Atoxon* from Mozambique, Mt. Gorongosa. Only three juvenile specimens were available to him, the largest having a body length of 24 mm. The latter had a fully developed hermaphrodite gland, but the other parts of the genital system were still undeveloped (Verdcourt's fig. 6). The hermaphrodite gland differs from that of all other known *Atoxon*, being not embedded in the liver, but being placed at the extreme end of the viscera behind the liver. From the juvenile receptaculum seminis it may be concluded that the species belongs to the group of *Atoxon* with elongated bursa and shorter pedunculus.

*Body measurements* of the biggest specimen (Verdcourt 1962: 30-31):

	mm
Body length . . . . .	24
Mantle length . . . . .	10.5
Distance between respiratory orifice and posterior mantle margin . .	4
Sole length . . . . .	22
Sole breadth . . . . .	3.9
Breadth of mid-area of sole . . . . .	1.3

Full description and naming of the species will be only possible when adult specimens are obtained.

*Distribution:* Mozambique, Mt. Gorongosa, 1220 m, leg. E. Pinhey IX.1957.

*Atoxon? spec.*

A juvenile specimen of 25 mm length was collected in Malawi on the Zomba Plateau. Its reproductive organs are still so undeveloped that an identification is impossible.

*External characters:* The back ends in a caudal horn. The mantle is shagreened, the hind end of the body reticulate. The mantle and back are olive gray, becoming lighter on the flanks. The mantle has dark lateral stripes with dark mottling in between. The back has a light median stripe.

*Body measurements:*

	mm
Body length . . . . .	25
Body breadth in middle . . . . .	4
Mantle length . . . . .	10
Length of shell slit . . . . .	0.2
Distance between respiratory orifice and anterior end of mantle . . . . .	5.5
Distance between respiratory orifice and posterior end of mantle . . . . .	3.8
Length of sole . . . . .	14
Breadth of sole in middle . . . . .	4.1
Breadth of mid-area of sole in middle . . . . .	1.1

*Reproductive organs:* A stimulatory organ is missing. The organs are in such a stage that epiphallus and penis are still fused together. The undeveloped hermaphrodite gland is embedded in the liver.

*Locality:* Malawi, Zomba Plateau 1500 m, leg. T. B. Oatley 16.V.1964.

Genus *Dendrolimax* Heynemann, 1868

*Dendrolimax* Heynemann, 1868. Malak. Bl., 15: 32. Type-species: *Dendrolimax heynemanni* "Dohrn" Heynemann, 1868. The following species of *Dendrolimax* have hitherto been described:

*Dendrolimax heynemanni* "Dohrn" Heynemann, 1868. Malak. Bl., 15: 35, pl. 1 figs. 1 a-g (habitus, shell, mandible, radula). Type-locality: Island Principe, gulf of Guinea.—Semper 1870, Reisen Arch. Philippinen, (2) 3: 20, pl. 4 fig. 12 (reproductive organs).

*Dendrolimax greeffi* Simroth, 1889. N. Acta Leop. Carol. Akad., 54 (1): 60, pl. 4 figs. 1, 2 (habitus, reprod. organs). Type-locality: Island São Thomé, gulf of Guinea.

*Dendrolimax continentalis* Simroth, 1896. Abh. Senckenb. naturf. Ges., 19 (3): 300, pl. 1 figs. 1-6 (mantle, habitus, reprod. organs). Type-locality (restr.): Togo, Bismarckburg.

*Dendrolimax leprosus* Pollonera, 1906. Boll. Mus. zool. Torino, 21 (543): 6. Type-locality: Uganda between Kjiemula and Madudu.—Pollonera 1909, 11 Ruwenzori, 1: 189-192, pl. 3 figs. 1-5 (habitus, mantle, repr. organs, mandible).

*Dendrolimax osborni* Pilsbry, 1919. Bull. Amer. Mus. nat. Hist., 40: 291, fig. 148 a-c (repr. organs), pl. 8 fig. 5 (habitus). Type-locality: Congo, Kivu, Rutshuru.

*Dendrolimax spec.* Verdcourt, 1960. J. East Afr. nat. Hist. Soc., 23 (6): 233, 235, fig. 5 (reprod. organs). From Kenya, Chania gorge at Thika, about 27 miles north of Nairobi.

The taxonomic characters of the species and forms mentioned above and those of the *Dendrolimax* newly discovered in Rhodesia are grouped in tables 2 and 3.

The *Dendrolimax* from Rhodesia corresponds in each character with *Dendrolimax greeffi*. Comparison of specimens from Rhodesia with the description and figures of *greeffi* has established that there are neither morphological nor anatomical differences justifying a specific or even subspecific differentiation, despite the great distance between their respective localities.

*Distribution:* All species, except *Dendrolimax greeffi*, are known on a few specimens from isolated localities. Verdcourt (1962: fig. 13) has published a distribution map. West

TABLE 2  
Keel of *Dendrolimax*

	<i>Keel extended along the whole back</i>	<i>Keel limited to the distal part of the back</i>	<i>Keel frilled</i>	<i>Keel not frilled</i>
<i>Dendrolimax</i>				
<i>heyneimanni</i> .. .. .	*	—	*	—
<i>greeffi</i> .. .. .	*	—	*	—
<i>continentalis</i> .. .. .	*	—	—	*
<i>osborni</i> .. .. .	—	*	—	*
spec. Verdcourt, 1960 from Kenya .. .. .	?	?	?	?
form from Rhodesia .. ..	*	—	*	—

Africa: *Dendrolimax heyneimanni* on Principe Island, *D. greeffi* on Sao Thomé, and *D. continentalis* in Togo. Central African Highlands: *Dendrolimax leprosus* in Uganda, *D. osborni* in Kivu Province of the Congo, and *D. spec.* Verdcourt 1962 in Kenya near Nairobi. The new record from Rhodesia enlarges the known distribution of the genus considerably to the south. It is to be expected that the gaps in the known distribution of *Dendrolimax* are caused by insufficient collection of African slugs, and may be filled by future authors.

*Dendrolimax greeffi* Simroth. Figs. 41-43

*Dendrolimax heyneimanni*.—Heyneimann 1882, Nachr.-Bl. dtsch. Malak. Ges, 14 (11/12): 183, not *Dendrolimax heyneimanni* Heyneimann, 1868.

*Dendrolimax greeffi* Simroth, 1889. N. Acta Leop. Carol. Akad., 54 (1): 60, pl. 4 figs. 1, 2. Type-locality: Island São Thomé, gulf of Guinea.

Heyneimann (1882: 183) described two specimens collected by Prof. Greeff on São Thomé, and considered them to represent *Dendrolimax heyneimanni*. He sent one of these to Simroth, who described it (1889: 60-61, pl. 4, figs. 1, 2) as *Dendrolimax greeffi*. Both descriptions are very poor. As mentioned before, the *Dendrolimax* from Rhodesia is identical with *D. greeffi*.

*External Characters* (figs. 41 a-d): A stout slug, becoming mature with a length of nearly 40 mm. The back has a median keel, frilled on its posterior half, and ends in a caudal horn. The upper longitudinal grooves run parallel to the keel, the lower obliquely to an irregular longitudinal groove, parallel to the peripodial groove. The longitudinal grooves are connected by transversal grooves at irregular distances. Deep grooves run on both sides of the head from the anterior attachment of the mantle to the anterior end of the foot (on the right to the genital orifice). The region between these grooves is covered by small rugae. The mantle is anteriorly attached behind its pointed apex. Its rounded posterior end is situated in a corresponding deepening of the back. The ground colour is almost khaki with irregular whitish markings. The latter are somewhat warty and of different form and size. On one specimen they cover nearly the whole body, except the grooves.

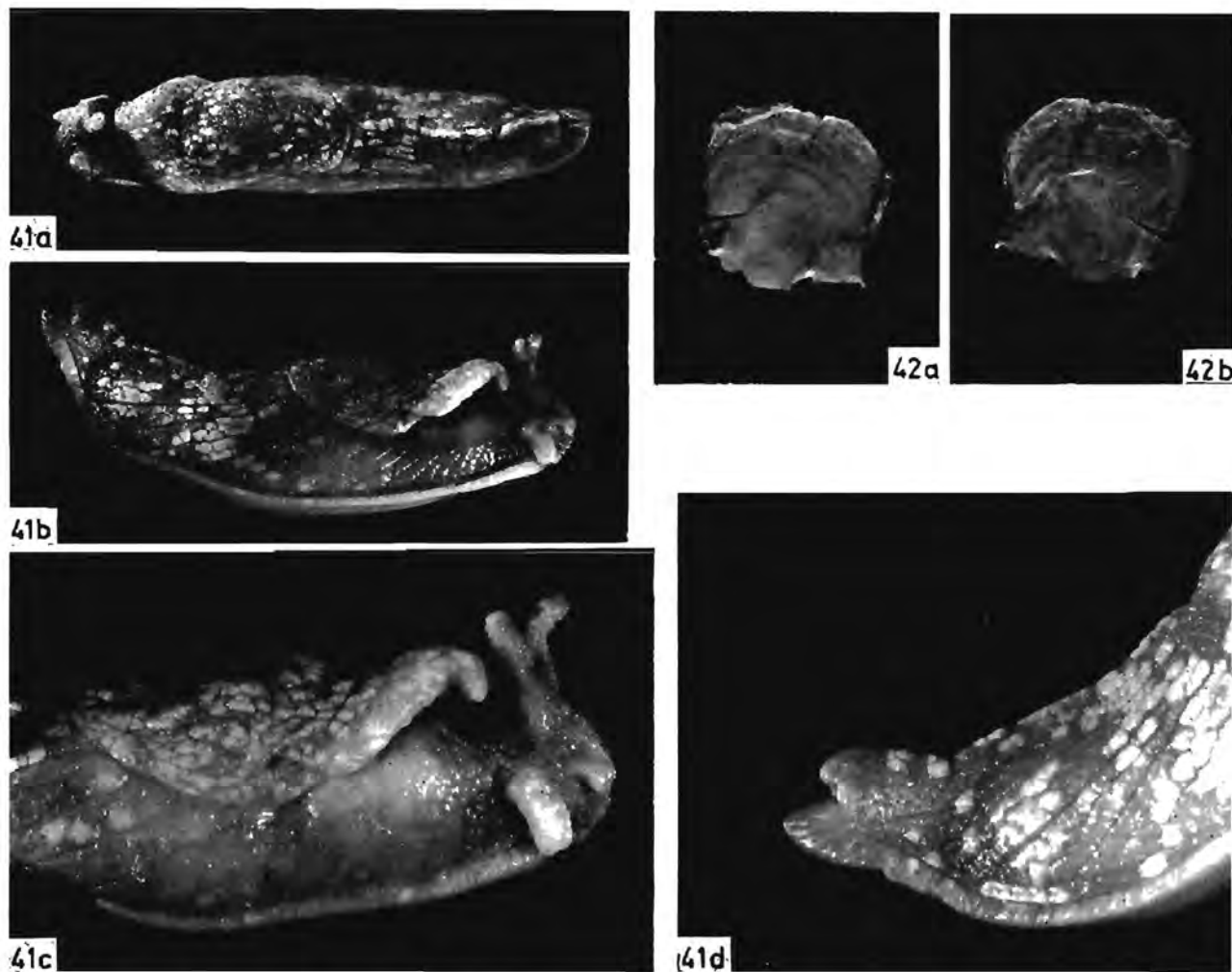
TABLE 3  
Reproductive organs of *Dendrolimax*

	<i>Uterine gland</i>		<i>Vagina</i>		<i>Bursa of receptaculum seminis</i>		<i>Epiphallian flagellum</i>		
	<i>present</i>	<i>wanting</i>	<i>present</i>	<i>wanting</i>	<i>longer than pediculus</i>	<i>not longer than pediculus</i>	<i>longer than flagellum of penis</i>	<i>equal to flagellum of penis</i>	<i>shorter than flagellum of penis</i>
<i>Dendrolimax heynemanni</i> . . . . .	—	*	*	—	*	—	—	*	—
<i>greeffi</i> . . . . .	*	—	*	—	—	*	*	—	—
<i>continentalis</i> . . . . .	*	—	*	—	*	—	*	—	—
<i>leprosus</i> . . . . .	*	—	—	*	—	*	—	—	*
<i>osborni</i> . . . . .	*	—	*	—	—	*	—	*	—
spec. Verdcourt 1960 from Kenya	*	—	*	—	—	*	?	?	?
form from Rhodesia . . . . .	*	—	*	—	—	*	*	—	—



TABLE 4  
Measurements of *Dendrolimax greeffi* from Rhodesia

	<i>body length</i>  <i>mm</i>	<i>mantle length</i>  <i>mm</i>	<i>length of back</i>  <i>mm</i>	<i>length of shell-slit</i>  <i>mm</i>	<i>distance of respiratory orifice from</i>		<i>distance of basal end of mantle-slit from</i>		<i>wide of sole in length-middle</i>	
					<i>anterior mantle end mm</i>	<i>posterior mantle end mm</i>	<i>anterior mantle end mm</i>	<i>posterior mantle end mm</i>	<i>side areas  mm</i>	<i>middle area  mm</i>
from Mt. Selinda 1070 m dissected specimen other specimens . .	45	18.2	19.5	1	12	10	9.7	13	2.3	2.3
	25.5									
	22.8	9.6	10.2	0.4	6	5.5	4.5	7	1.5	1
	23 22									
from Mt. Selinda 1100 m dissected specimen other specimens . .	39.7	19.6	20.5	0.9	11.2	11.5	9.1	11.4	2.2	2
	38.5	15	18.5	0.4	9	9	7.5	11	2	2
	35.5	15	15.5	0.8	8.2	8.3	7	9.3	2.5	2.5
	38									
chalky-white specimen	30.8	15.1	16	0.8	8.2	8.2	7	9.8	2	2.2



Figs. 41, 42. *Dendrolimax greeffi* Simroth, from Rhodesia, Mt Selinda, Chirinda Forest. (41) (a) dorsal view, (b) lateral view, x2.25, (c) lateral view of hind end, (d) lateral view of head with partly erected genitalia, x4.5. (42) (a) dorsal view, (b) ventral view, of shell, x7.5.

*Body measurements:* Neither Heynemann (1882: 183 nor Simroth 1889: 60-61) has published any body measurements. The length of the figure of the type-specimen (Simroth 1889: pl. 4, fig. 1) is 39 mm, but Simroth did not state whether this figure shows the natural size.

*Shell* (fig. 42 a, b): The shell is reduced to a thin calcified plate with vaulted nucleus. The examined, incomplete shell measures 3.6 mm in length and 3.9 mm in breadth.

*Reproductive System* (figs. 43 a, b): The small ovotestis is connected by a short, straight hermaphrodite duct with the voluminous albumen gland. The long ovispermiduct is convolute. Except a short distal part, the uterus is embedded in a voluminous uterine gland. The receptaculum seminis consists of an oval bursa (in one specimen with a rounded tip and in the other pointed) and of a pediculus being about one and a half times as long as the bursa. The vagina and penis unite to form an atrium, being partly exerted in one specimen (fig. 43 a). The long vas deferens inserts onto the epiphallus at the base of a long epiphallian flagellum. Calcareous substance has been observed in the epiphallus near the insertion of the vas deferens, but not in the epiphallian flagellum. The epiphallus inserts laterally in the penis. The penial flagellum is shorter as the epiphallian flagellum. In one specimen the penial sheath contains a slender penial verge, ending in a pointed glans (fig. 43a); in the other specimen the proximal part of the penial verge is swollen and bent, containing a spermatophore (fig. 43b). The penial retractor inserts at the posterior part of the penial sheath. In the other specimen it was accidentally torn when dissecting.

*Locality:* Rhodesia, Mount Selinda, Chirinda Forest, 1070—1100 m, leg. A. C. and W. H. van Bruggen 15.-16.I.1959 and 7.-13.II.1963.

*Distribution:* *Dendrolimax greeffi* is known from São Thomé in the gulf of Guinea and from Rhodesia. The occurrence in a discontinuous pattern may be due to different reasons. Either these occurrences are relics of an earlier comprehensive distribution, or this species still has a much wider distribution, as yet unknown on account of the fragmentary knowledge of African slugs.

### Genus *Leptichnus* Simroth, 1896

*Leptichnus* Simroth, 1896. Abh. Senck. naturf. Ges., 19: 296. Type-species: *Leptichnus fischeri* Simroth, 1896.

Two forms of *Leptichnus* have been described:

#### *Leptichnus fischeri* Simroth, 1896.

Abh. Senck. naturf. Ges., 19: 296, pl. 1 figs. 7-11. Type-locality: Tanzania (= Deutsch-Ostafrika) without further details. Martens (1879a) described some molluscs G. A. Fischer collected 1879 at Bagamajao at the east coast of Tanganyika. *Leptichnus fischeri* was perhaps collected at the same locality.

#### *Leptichnus* spec. Verdcourt 1960.

J. East Afr. nat. Hist. Soc., 23 (5): 201-203, fig. 1. Locality: Tanzania, East Usambaras, Amani, Mt. Bomole.

A third form, described below as *Leptichnus verdcourtii* n.sp., was discovered in Mozambique and Rhodesia.

*Distribution:* *Leptichnus* was hitherto known only from Tanzania (Tanganyika). The newly discovered species from Mozambique and Rhodesia extends the known distribution of the genus considerably southward.



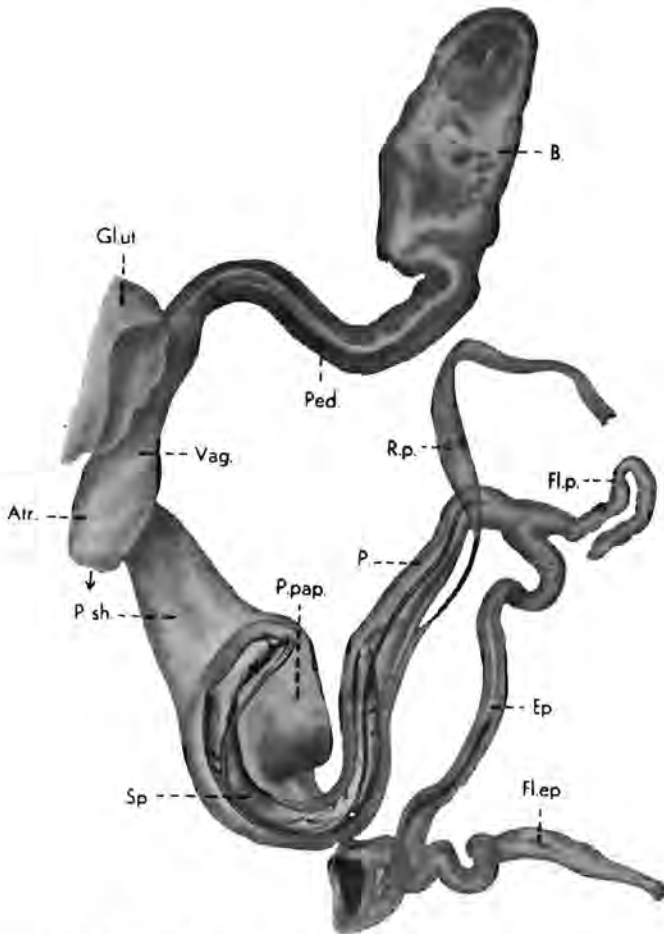


Fig. 43b. *Dendrolimax greeffi* Simroth, from the same locality as 43a. Terminal parts of reproductive organs, penis containing a spermatophore. Explanation of abbreviations on p. 509.

***Leptichnus verdcourti* n.sp. Figs. 44-46**

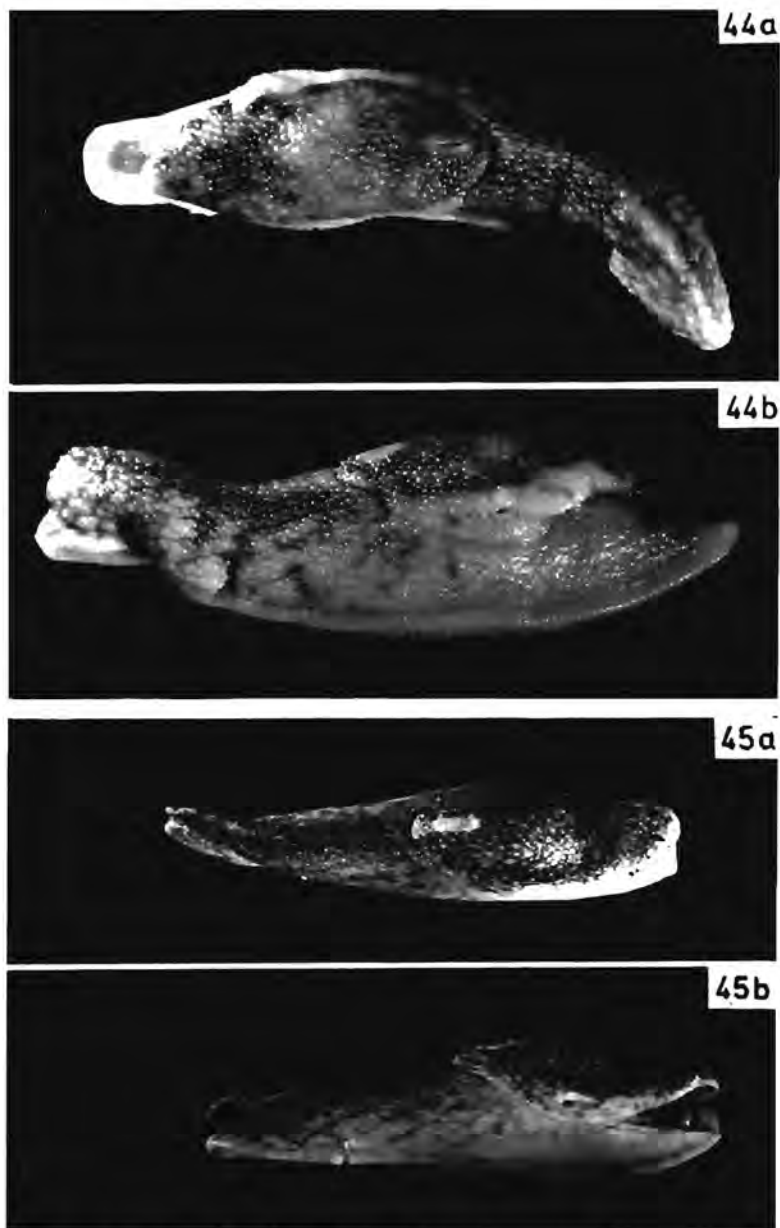
Holotype in Natal Museum, Pietermaritzburg.

*Type-locality:* Mozambique, Amatongas Forest, 520 m. One paratype from Rhodesia, Mount Selinda, Chirinda Forest 1070 m, in Rijksmuseum Natuurlijke Historie, Leiden.

*Etymology:* *Leptichnus verdcourti* n.sp. is dedicated to B. Verdcourt, Ph.D., F.L.S., B.Sc. in recognition of his promotion of East African malacology.

*Diagnosis:* *Leptichnus verdcourti* differs from *L. fischeri* and *Leptichnus spec.* Verdcourt 1960 in that its visceral cavity penetrates into the foot, but contracted in the distal part of the body and limited to its lower half.

*External Characters* (figs. 44 a, b, 45 a, b): A small slug, adult at a length of  $\pm 23$  mm. The distal two thirds of the back are keeled. The caudal horn of the holotype is small, that



Figs. 44, 45. *Leptichnus verdcourtii* n. sp. (44) Holotype from Mozambique, Amatongas Forest, (a) dorsal view, (b) lateral view, x3. (45) Paratype from Rhodesia, Mt Selinda, Chirinda Forest. (a) dorsal view, (b) lateral view, x3.

one of the paratype bigger. Oblique grooves are present only at the flanks. On the back there are irregular small rugae, isolated by deep grooves. The mantle is granulate, the

granules so acute as to make the mantle appear prickly. The ground colour is pale yellow. The darker pigmented upper parts are grayish yellow in the holotype and olive-brown in the paratype. The back of the holotype has a pale yellow median stripe, bordered on both sides by grayish stripes with irregular borders below. The back of the paratype has neither a light median nor darker lateral stripes. The centres of the rugae on the back of the paratype are pale yellow. The mantle of the holotype has a grayish yellow central area, bordered on both sides by indistinct darker stripes and narrow pale yellow lateral margins. The mantle of the paratype has an olive brown central area with indistinct lateral stripes. The pale yellow lateral margins have darker spots. The granules are pale yellow.

*Measurements:*

	<i>Holotype</i> <i>mm</i>	<i>Paratype</i> <i>mm</i>
Body length .. .. .	29.3	23.3
Body breadth in middle .. .. .	5.6	4.2
Length of mantle .. .. .	15.4	12
Length of shell slit .. .. .	1.5	1.1
Distance between respiratory orifice and anterior end of mantle .. .. .	10.4	7.5
Distance between respiratory orifice and posterior end of mantle .. .. .	7.2	5.3
Length of sole .. .. .	30.7	22.5
Breadth of sole in middle .. .. .	3.8	3
Breadth of mid-area of sole in middle .. .. .	1	0.5

*Shell* not examined.

*Reproductive system* (fig. 46): The hermaphrodite gland was not examined. The long ovispermiduct is feebly convolute. The uterus is composed of a distal part of the same structure as that of the ovispermiduct, and a short widened section, divided by a constriction of the long straight proximal section. The latter has muscular walls and in its distal part a convolute duct. The receptaculum seminis consists of the bursa, oval with a pointed distal end in the holotype and globular in the paratype, and of a pediculus, being about twice as long as the bursa. The pediculus is inserted onto the side of the uterus in the atrium, a vagina being absent. The vas deferens is inserted onto the epiphallus at the base of a long epiphallian flagellum. The epiphallus is relatively short, containing calcareous substance. It inserts onto a more voluminous penis. The penial sheath is long and contains a penial verge. The penial flagellum is shorter than the epiphallian flagellum. A penial retractor inserts at the penial sheath of the paratype. It is absent in the holotype; probably it was torn during dissection.

*Habitat and distribution:* Mozambique, Amatongas Forest, 520 m, leg. A. C. & W. H. van Bruggen 19.II.1963 (type-locality). Rhodesia, Mt. Selinda, Chirinda Forest, 1065 m, in forest, leg. A. C. van Bruggen 14.-26.I.1959.

*Taxonomy:* If later research on a greater number of specimens establishes the differences between holotype and paratype as being constant, they may probably be distinguished as subspecies.

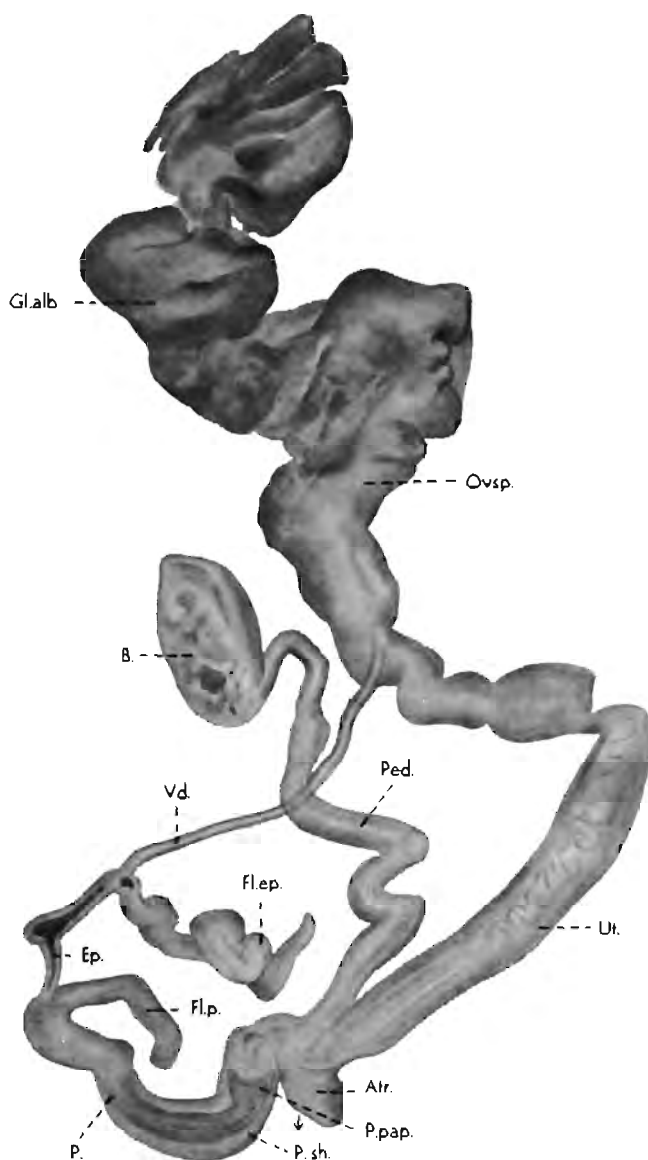


Fig. 46. *Leptichnus verdcourtii* n. sp., holotype from Mozambique, Amatongas Forest. Reproductive organs. Explanation of abbreviations on p. 509.

#### LOCATION OF MATERIALS

The slugs described in this paper are in the collections of the Natal Museum, Pietermaritzburg (Natal, South Africa); some duplicates have been deposited in the Rijksmuseum van Natuurlijke Historie, Leiden (Netherlands), and in the Museum of Natural History, Basle (Switzerland).



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